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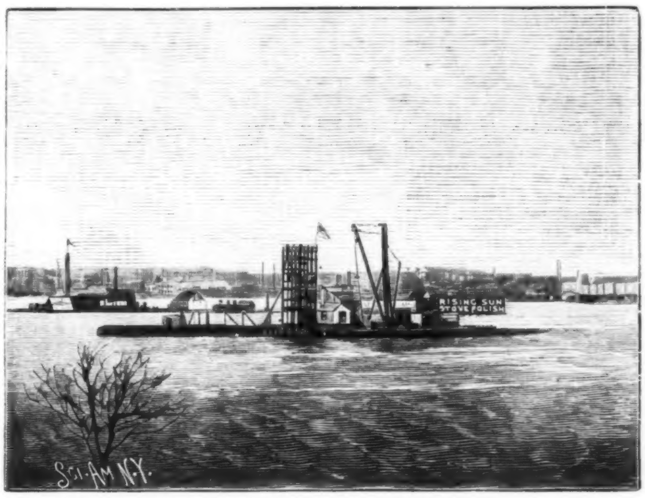
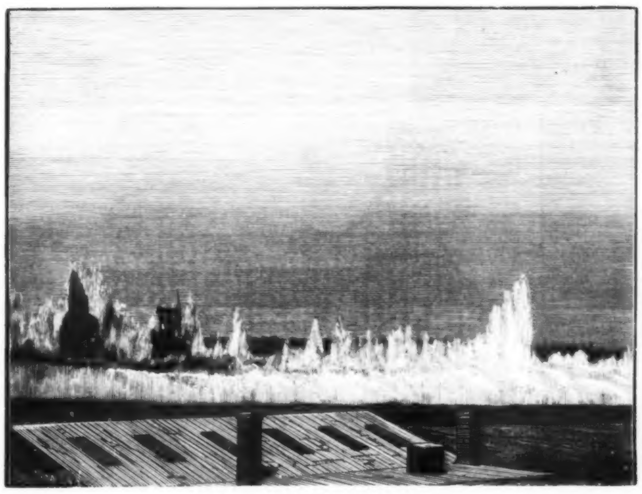
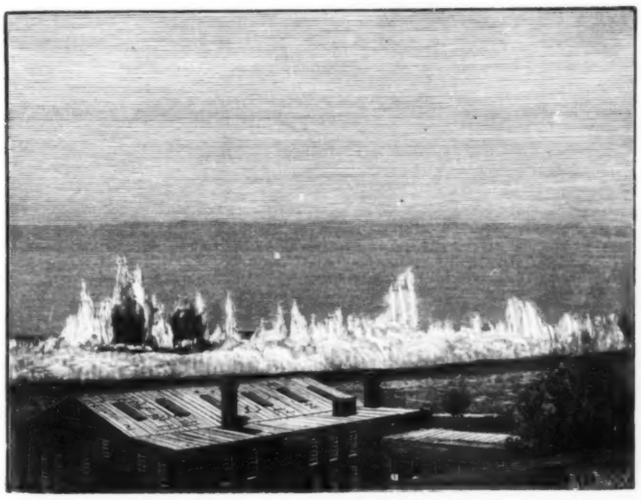


JUST BEFORE THE EXPLOSION.

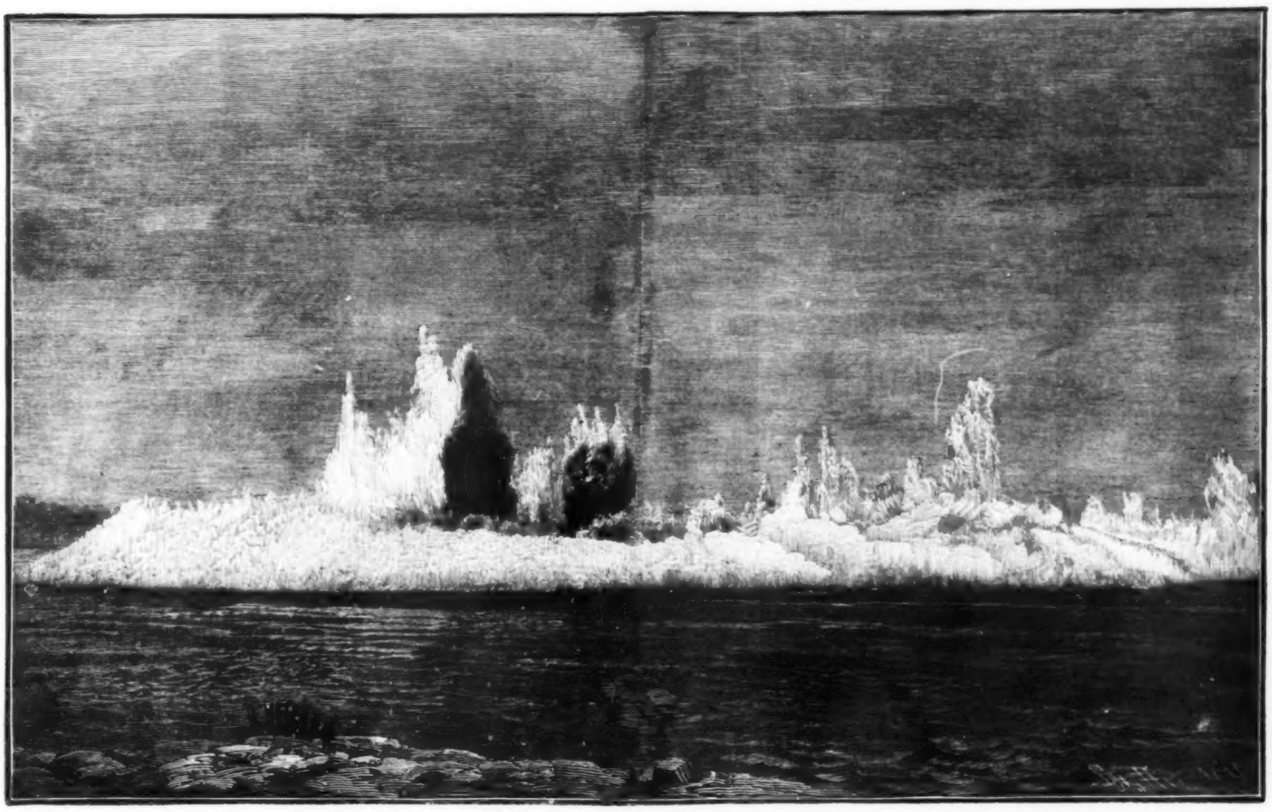
JUST AFTER THE EXPLOSION.



THE WATER RISING.



THE WATER NEARLY AT ITS HEIGHT.



FLOOD ROCK EXPLOSION.—THE WATER AT ITS HEIGHT.

BLOWING UP FLOOD ROCK, HELL GATE.

ONE of the most formidable obstructions by which the shipping entering New York Harbor by way of Long Island Sound has been menaced was the ledge of granite known as Flood Rock, which was located in the East River, opposite to 94th St., New York, and near the opposite shore of Astoria and Hallet's Point. Only the apex of this irregular conical mass of Flood Rock was visible above the water at high tide, but its gradually sloping sides extended in all directions under water, and made a dangerous obstruction to navigation. Its location was particularly disadvantageous, being at the bend of the channel, and almost in the center of a current which at certain periods of the tides attained a velocity of eight and a half miles an hour. The necessity of its removal became early apparent. The work was started in 1875, but has been greatly delayed by the tardy action of Congress in voting the requisite appropriations. It has been planned and carried out by Gen. John Newton, Chief of Engineers, U. S. A., and has been under the personal supervision of his assistant, Lieut. Derby.

A shaft was sunk at the highest point of the rock to a depth of 60 feet below water level. From this shaft, galleries were extended parallel with the current, and connected at regular intervals by cross galleries running at right angles with the first series. Hallet's Point Reef was exploded in 1876, and sufficient rock was removed to permit the superincumbent mass to sink into the large chambers beneath, and thus afford the requisite depth of water. At Flood Rock, however, a different plan was pursued. It was found cheaper to simply break up the rock, and then remove it by dredging. Consequently the galleries were only expected to afford the means of honeycombing the rock, and introducing sufficient explosives to blow it to pieces. A good idea of the magnitude of the work will be obtained from the ground plan of the completed excavations.

1. Deep Drainage Ditch. 2. Appearance of a Gallery. 3 Door for Shutting off the Northeastern Portion. 4. View of Flood Rock. 5. Charging the Drill Holes. 6. Plan of Drill Holes for one Column and Adjoining Galleries. 7. Numbering of Holes. 8. Cartridge. 9. At the Foot of the Main Shaft.

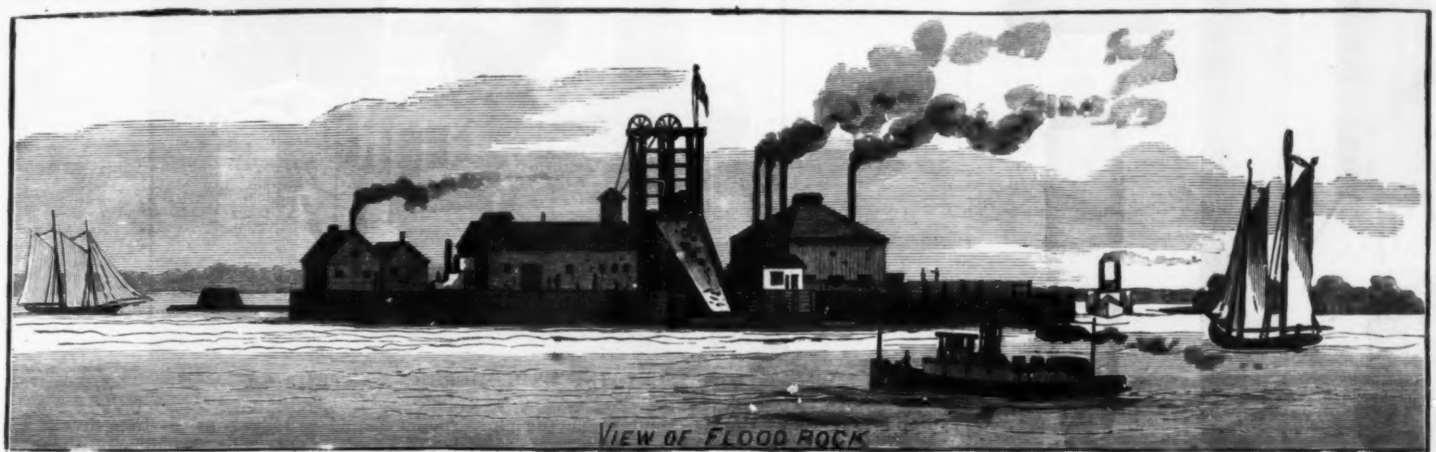
FINAL OPERATIONS FOR THE REMOVAL OF FLOOD ROCK, HELL GATE, N. Y.

The area thus penetrated covered about nine acres. The galleries were made about 10 feet high, and their aggregate length was 21,670 feet. The rocky roof above averaged a thickness of 15 feet, and was supported by 467 columns. The 24 galleries running parallel with the East River had an extreme length of 1,200 feet, while the longest of the 46 at right angles to the channel was 625 feet. Some difficulty was experienced during the mining operations from encountering fissures in the rock which admitted considerable quantities of water. Fortunately, however, they never became so large as to flood the workings. Yet with the greatest caution it was always a very wet place, as can be fancied from our illustrations, and gave ample work to the pumps. The rock of the northeastern portion was particularly porous, and made it prudent to separate this part of the working from the main galleries by means of a strong door, so that in case of accident the entire mine should not be flooded. The heavy drainage from the workings was brought to a deep sump near the base of the shaft, by means of a transverse ditch which connected with others encircling the entire area. Pumping engines having a capacity of 4,000 gallons per minute were placed at the main shaft, and raised the contents of the sump to the surface.

For the introduction of the explosives for the final discharge, 13,286 holes were drilled in the columns and roof. They were 3 inches in diameter, and averaged 9 feet in depth. The total length of the drillings was over 22 miles. During the progress of the work, an accurate plan was kept, showing the location and number of each hole, together with its inclination and depth. In the columns, the holes were about five feet apart, and extended upward at an angle of 45°. Those in the roof were about four feet apart, and at an angle of 60° to 65°. No holes were drilled near the floor. When this work had been completed, the holes were charged with dynamite and "rackarock" powder. Portable rails were laid in the different passages, and a small car provided with suitable frames employed for reaching the drillings.

The first cartridge introduced into each hole was of rackarock (2) with dynamite exploder (3). The cartridges were 24 inches long and 2¼ inches in diameter, holding each six pounds of the explosive. Rackarock is a mixture of chlorate of potash and dinitro-benzole, two ingredients which are perfectly harmless until combined. The mixing was done upon Great Mill Rock in a lead-lined vat, the chlorate being made to pass through a fine sieve, and the benzole being then added in the requisite proportion. The explosive thus formed had by actual test a strength nine per cent. greater than No. 1 dynamite. The cartridge cases were then filled with this substance, which resembles moist light brown sugar in appearance. It was forced into place by a wooden rammer, and a cap soldered upon each case. A fusible alloy was employed which melts at 112°. Four wires projected outwardly from the bottom of each case, and served to hold the cartridge in the drill hole. The exploder (3) for this cartridge consisted of a copper tube filled with No. 1 dynamite, and provided with a little shell of fulminate of mercury, as shown in the illustrations. A cork stopper was placed in the open end of the copper tube, which was then dipped in glue and a copper cover put on. The exploder was pushed some distance into the cartridge. After the rackarock cartridges had been inserted into the drill hole, one of the same size and filled with dynamite (1) was added. This was furnished with an ordinary exploder of fulminate

FORMER APPEARANCE OF FLOOD ROCK



VIEW OF FLOOD ROCK

MAP OF HELL GATE ORIGINALLY.

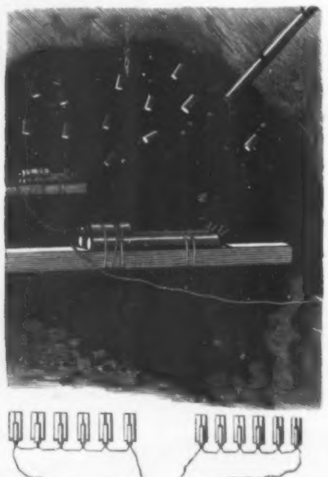
BIRD'S EYE VIEW OF HELL GATE AND VICINITY.

BLOWING UP FLOOD ROCK, HELL GATE.

of mercury. To protect the cartridges from corrosion, they were all first dipped in oil and pitch, and then rolled in sand. The dynamite cartridge was permitted to extend six inches beyond the surface of the rock, so as to receive the force of the mine exploder (5), a brass cylinder, 7½ inches long by 1¾ inches in diameter, filled with dynamite.

THE CARTRIDGES AND EXPLODERS.

Inclosed within the dynamite was a fuse (4), consisting of a copper tube nearly filled with 30 grains of fulminate of mercury, the wires from which passed through a divided cork in the mouth of the brass cylinder (5). Within the open end of this tube was a second one containing sulphur, through which passed two conducting tubes. The inner ends of the wires were connected by a platinum wire of much smaller diameter. They were then surrounded with fulminate, and the two tubes put together as shown. The entire fuse was covered with gutta percha. The passage of an electric current through the wires heats



THE FUSES AND FIRING CARTRIDGES IN PLACE.

the platinum to redness, and thus explodes the fulminate.

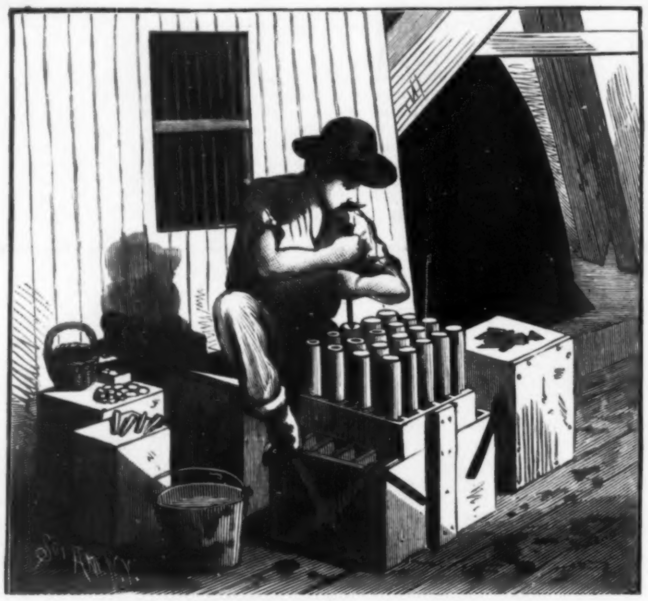
It will be noticed that by the use of the mine exploder, not one of the cartridges in the drill holes was connected with wires, nor was one exploded directly by electricity. At intervals of 25 feet, 3 by 5 inch timbers extended from wall to wall. A mine exploder, tied to two dynamite cartridges (see above), was fastened to each of these timbers. The entire mine was divided into 24 independent circuits, each of which contained 25 mine exploders. Each of these circuits had an independent surface connection, all being fused at once by means of the electrical apparatus shown. One end of each of the 24 wires was placed in a cup of mercury, and the other ends similarly connected in another cup of mercury. A wire led from the left hand cup to one pole of a battery. From the other cup, a wire, C, extended to the bottom of an intermediate cup containing only a little mercury. A wire, B, led from the other pole of the battery, and was held suspended over the mercury in the center cup. By increasing the level of the mercury until it reached the wire, B, the circuit was completed and the exploders fired.

At A, a fuse was held to the string carrying the wire, B. One wire passing through this fuse was grounded, while the other led to the shore, where it was also grounded. A battery on shore was placed in this circuit, and by exploding the fuse, A, allowed the wire, B, to drop into the center cup, and thus explode the mine. As a precaution in case any accident happened to the shore battery, a funnel of mercury was placed over the center cup; and while allowing the officers plenty of time to leave the island after adjusting the apparatus, it would in time have closed the circuit by raising the level of the mercury, and thus exploded the mine. The shore line was not necessary to the successful firing of the charge, but was devised mainly for the benefit of scientists, who wished to observe the rate of vibrations propagated in the earth.

At precisely 11 o'clock and 14 minutes on the morning of October 10, 1885, the enormous charge of 150 tons of dynamite and rackarock powder—the largest charge of explosives ever fired at once—was successfully exploded. The firing of the 600 mine fuses caused the dynamite cartridges projecting from the drill holes to explode by sympathy, and these in turn discharged the rackarock behind them. The volume of water rose in irregular masses, as if many gigantic fountains, each playing independently, were at work beneath the surface. The mass measured at least 1,400 feet in length, 800 feet in width, and 200 feet in height. There was one heavy report, followed by a lighter one from the northern end of the work. But one severe shock was felt; there was no series of vibrations. In our illustrations is shown the appearance of the rock before and after the explosion, and of the water rising, nearly at its height, and at its maximum.

The result of so tremendous an explosion was naturally sought with some anxiety, since it determined the success or failure of a ten years' undertaking. The examination so far has shown a very gratifying condition of affairs. The rock over the entire area of nine acres seems well broken up, and the dredging is now in progress. Some of the large fragments will require blasting before they can be removed, but this is regarded as much more favorable for cheap working than a finely shattered condition would have been.

Observations made at Harvard College showed the rate of transmission of the vibrations to have been 5,120 feet per second. At the time of the Hallet's Point explosion in 1876, when 25 tons of dynamite were exploded, Gen. Abbot found the rate of transmission in the drift formation of Long Island to have been 5,300 feet per second for a distance of 13½ miles. Considering the difference in the formations and distance, these results are very close.



INSERTING EXPLODERS IN CARTRIDGES.

THE MANIPULATION OF HEAVY FORGINGS.*

By Mr. T. Putnam, Darlington.

In dealing with the subject of heavy forgings, I propose to confine the limits of this paper to such as are used in the construction of a steamship, viz., the stern frame and rudder.

To an audience in a shipping district such as this, it is hardly necessary to remark that such important factors to the safety of a vessel as the stern frame and rudder should be reliable as to strength and soundness. This reliability is dependent upon the methods adopted in their construction.

I regret to say that until lately too little attention has been paid to this subject by those chiefly interested; the consequence has been serious losses in the shipping world through the giving way of imperfectly made stern frames and rudders.

I am informed by Lloyd's that during the last three years, on the east coast alone, something like fifty broken frames have come under their notice, and in one week recently no less than seven steamers put into port with defective stern frames.

These facts deserve serious thought. A steamer at sea with a broken shaft may weather through, but with her steering power gone she is a very helpless affair.

On the table you will observe the defective welds, specimens A and B, cut from the after post of two of the steamers mentioned above.

The cause of these failures, and how to prevent such occurring, I will endeavor to show.

First, I will deal briefly with the general practice in the manufacture of the forgings of a stern frame, which is made up by three separate pieces, the forward piece, A, the after piece, B, and the keel piece, C, Fig. 1.

The forgeman commences the forward piece by making a butt, A, on the porter or carrying bar, B, Fig. 2; on the top of this butt a number of slabs are laid, with small blocks of iron between each slab to insure thorough heating. After being heated they are hammered down, and a similar arrangement of slabs laid up on the opposite side of the butt. This is repeated alternately until a square mass of solid iron is laid up, sufficient to form the boss, which is then rounded under the hammer. A steel punch is now driven through the center of the mass, and the arch or upper

THE ELECTRICAL FIRING APPARATUS.

* Paper read before the Cleveland Institution of Engineers.—*Engineering.*

portion of the forward piece drawn out, as shown in Fig. 3. In the case of large frames having double posts, the upper part is forged as shown in Fig. 4, the arch being afterward bent to the required radius by the smith. This enables the largest frame to be made in three pieces, instead of four, and sometimes five, the usual practice. After finishing the upper end, the carrying bar is cut off, the piece turned, and the lower part drawn out. In forging the after piece, iron is laid up in sufficient quantity to enable the forgeman to cut out the wing of the arch, A, Fig. 5, the post is drawn away, the gudgeons, C, being forged on at the same time solid. The keel piece, Fig. 6, is forged in a somewhat similar manner, the wings of the after and forward pieces being cut out of a solid mass, as shown by the dotted lines in Fig. 6. After drawing the keel out, the porter is cut off, the forging turned, and the heel or lowest gudgeon shaped. You will notice that butts are left on each end and wing of the three forgings.

From the hammer the forgings are generally passed direct to the smith, to be dressed to the required sizes. In well-regulated forges, however, this practice has been abolished, the forgings being machined instead. By machining them, accuracy in working to the dimensions, which cannot be achieved by hand labor, is obtained. In addition, the repeated heating, tending to render the iron granular in structure, and cold hammering by the smith, necessary to produce an even surface, but which is apt to make the iron brittle, are avoided.

The forgings are now ready to be welded together, but before describing the processes by which this is effected, it will be advisable to consider what is to be attempted, and the difficulties that have to be encountered. Wrought iron has a characteristic property of assuming a soft, pliable condition through a long range of temperature below 2,000° C., its melting point, which enables two separate pieces to be united together, or welded. At a bright white heat this process can be so successfully accomplished that it is impossible to discover where the union has been effected, provided that, if there is not a sufficient amount of silicon combined with the iron to form a fusible cinder, a proper flux is used. The reason of this will be to many present obvious. In heating iron, a certain amount of scale is formed through oxidation of the surfaces in contact with the atmosphere. This scale, when consisting of pure oxide of iron, is infusible at a temperature higher than the welding point, but, if alloyed with silicon, it is converted into an exceedingly fluid and fusible silicate of protoxide of iron, which under proper pressure, correctly applied, is readily expelled; the clean surfaces of iron are brought into contact, and molecular cohesion takes place. Now, paying due consideration to this, to carry out the welding of two large sections of iron successfully, the three chief points to aim at are:

1. To obtain a temperature on the surfaces to be welded that is effective.

2. The arrangement of the two pieces in a manner that will enable the cinder to escape.

3. That the power applied to expel the cinder is sufficient.

To the heating too much attention cannot be paid. If the temperature be too low, the intervening cinder being in a viscous condition, its entire extrusion cannot be effected, and the outer edges of the bars are the only portions welded, the center of the bar being quite unsound. Specimen C shows this distinctly.

On the other hand, if the temperature is too high, and through this the bar is, to use a technical term, burnt, the iron becomes unworkable, and cannot be welded.

I can now deal with the final and most critical part of the whole process, viz., the finishing of the frame by the smith putting the forgings together.

In the practice most prevalent, that is, hand-welding by means of screws, the smith commences by cutting short scarfs, as shown in Fig. 7, allowing very little excess for waste during heating; and acting upon the assumption that what was good enough for welding engine tires would be good enough for a stern frame, he effects a weld by continually tightening the screws, thus drawing the two pieces together while in the fire.

Fig. 8 shows the arrangement of the screws and the tie-rods for effecting the weld in the arch, and Fig. 9 the arrangement of the same for welding the keel piece on to the forward and after pieces. Three-quarters of an inch is usually allowed for screwing; as soon as the pieces have been drawn up this amount, it is assumed that the weld is perfect. The frame is brought from the fire to the anvil, and a few blows are struck on the side of the scarf with a three-handed Johnny hammer, shown in Fig. 10.

The unreliability of this process is apparent, and is now perfectly well known; yet, chiefly for the reason stated at the commencement of this paper, it still continues in force in a very great number of forges.

In the first place, on account of the small amount of material left on the parts to be welded over the finished size of the frame, if the heating is continued for the requisite time, that is, until the scarfs or interior of the bar is at a welding temperature, the outer edges of the bar have wasted so much in the fire that it is below the required size; therefore, neither the shipbuilder nor Lloyd's would pass it. Consequently, to insure a full sized section in the finished frame, in order to pass survey, it frequently happens that the heating is not prolonged sufficiently to allow a welding heat to be obtained in the center. Again, the scarfs, or butts, being so short, or rather the angle on the inside of the scarf points being so great, any force applied on the side of the frame only tends to open the weld instead of further cementing it. Thirdly, from the time the two parts to be welded begin to heat until the frame is brought to the anvil, the screws are kept going by the smith, thus tightening up the faces of the scarfs.

Now this screwing, I am told at the different works where it is in vogue, really effects the weld. Hand hammering is merely a secondary consideration. So far as the hammering is concerned, this is correct; but for large sections, hand-screwing is not only useless but absolutely dangerous to the success of the weld, for the simple reason that the cinder originally on the face of the scarfs after cutting, and that formed during the heating, remain there when the frame is supposed to be finished.

The scarf faces are close together at the commencement of the heat; by being screwed up they are kept in close contact during the heat, and however fluid the cinder may be, there is no means or way by which it can escape; there it remains, an impenetrable and effectual barrier to metallic contact.

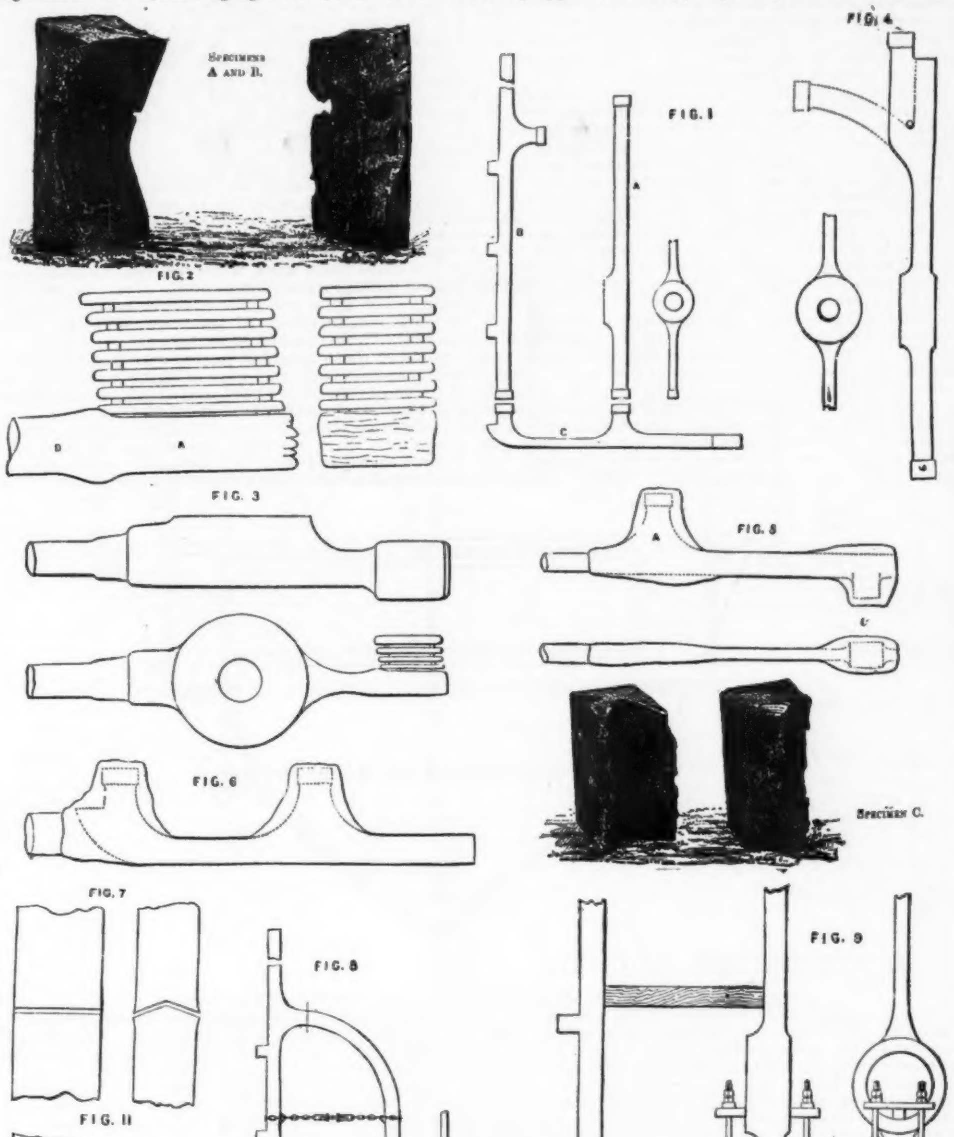
To these grounds, more particularly the latter, stern frame failures may be attributed; and knowing how repeated and numerous were the failures of engine tires welded by screw pressure, can it be a matter of surprise that stern frames with sections from 30 up to 150 square inches come to grief? In fact, is it not possible, taking into consideration the enormous strain thrown upon a stern frame by heavy seas striking the rudder of a heavily laden steamer, that the increasing number of cases in which steamers leave port, never to be heard of again, may be ascribed to this careless method? for the stern frame failing, the rudder goes, leaving both vessel and men at the mercy of the wind and waves.

I will now attempt to show you how this defective welding can be overcome, and actually is overcome.

Some years ago, the firm with which I am connected had occasion to deal with some large pieces of iron, which had been welded by screws, in the manner already described. A series of tests was applied; the unsatisfactory result decided to our minds that the butt joint hand-welded by screws was a wrong practice. We decided, therefore, upon making a series of test welds upon large sections under a powerful steam hammer. The results obtained were so successful that we came to the conclusion that to obtain properly welded stern frames we should have put down a hammer and cranes, specially designed to admit a stern frame of the largest size and allow the application of the hammer to any part of it. This was done. The hammer is shown in Fig. 10. It has a clear space of 30 ft. between the standards. The piston rod weighs two tons, and has a fall of 4 ft. With steam on the upper side of the piston, the blow given is equal to 30 foot-tons. By this method, when preparing for welding, the scarfs of the frame are cut as shown by the wooden model and by Fig. 11. They are beveled from the center of the bar to the outer edge, so that the two pieces only touch at a point in the center, thus allowing a ready means of escape for the cinder when under the action of the hammer. The butts left on each end of the forgings are never less than four in. over the finished size, so that the scarfs can be thoroughly heated, and plenty of force applied by the hammer, before they are reduced to the correct scantling. The forgings are slotted to the dead lengths, all screwing being done away with; in place of screws, etc., straps are used, to prevent any slipping or warping.

Lloyd's visiting committee, hearing of this process, on one of their annual tours paid a visit to our works to inspect it. They expressed great satisfaction at the advance, and a series of tests on a large scale was made under the supervision of their inspector of forgings, to ascertain how far the new process was successful. Mr. Cameron was the inspector; many of his colleagues from time to time accompanied him. His requirements were very rigid. Every weld had to be made under exactly the same conditions as a stern frame, and he insisted upon having the pieces scarfed and welded in his presence.

After welding, he then had a short heat taken upon the part where the two pieces came together, and, after being placed upon blocks under the hammer, they were bent to an angle of 30 deg., and then reversed and bent back again. This severe test having failed to start the weld, he had them put into the slotting machine, and cut through where the scarfs came together; in every case the welds were perfect. Not thinking at that time of reading any paper on the subject, most of these tests



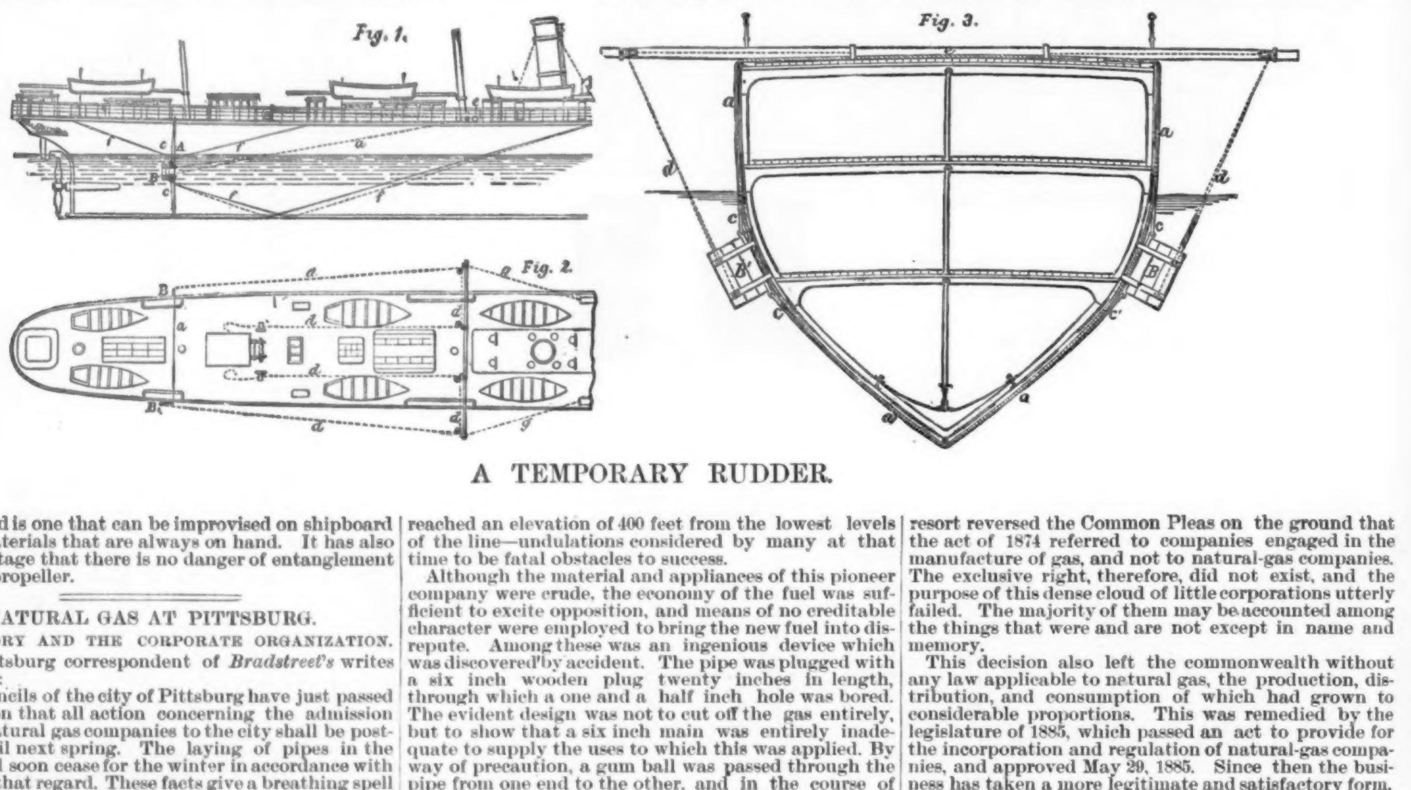
THE MANIPULATION OF HEAVY FORGINGS.

were relegated to the scrap heap; but two or three I have found, which are here for your inspection, one of them, a piece 15 in. by 7 in., marked D, and another 12 in. by 6 in., marked E, were treated as described above. The third, F, 10 in. by 7 in., was broken cold under the hammer, requiring eleven blows from a 13 ton piston-rod with a drop ranging from 6 ft. to 9 ft. before it fractured; all showed perfect union.

Another piece, 9 in. by 5 in., directly after welding, while still at a bright red heat, was bent alternately until the bar broke across without the weld showing the slightest sign of opening. I regret that I am not able to place this test, the most severe of all, before you, the pieces being at present in London. However, with the tests which are here I think you will concur that with proper appliances sound welds can be made. And if by directing attention to an evil which still exists, and which has been allowed to exist too long, a better system is insisted upon by those using these forgings, the object of this paper will have been attained.

A TEMPORARY RUDDER.

We have received from Mr. T. M. Lucas, the first officer of the S. S. Prinses Marie, says *Engineering*, a drawing of a temporary rudder which he has devised and tried with success on the Y at Amsterdam. The arrangement is shown in the engravings below, in which it will be seen that, in case of the main rudder being disabled or carried away, a small subsidiary rudder, B B', is rigged out at each side of the ship. Each rudder is pivoted to a steel wire rope, A, passing under the keel and across the deck, where it is made taut by a tackle. In addition to the frictional hold thus obtained, the steel rope is further guarded against displacement by means of the guard ropes, *f f*, two of which ran diagonally to the bulwarks, and two under the keel. The rudders are pivoted by straps or hinges, and are held by ropes, *c c*, by which they can be raised or lowered, the hinges sliding over the wire rope. The steering is performed by the ropes, *d d*, which run from the outer edges of the rudder round sheaves on the cargo boom, *e*, and thence to the steam winch, which draws in the one rope, and pays out the other, when it is rotated. The whole arrangement is exceedingly simple, and is one that can be improvised on shipboard out of materials that are always on hand. It has also the advantage that there is no danger of entanglement with the propeller.



A TEMPORARY RUDDER.

NATURAL GAS AT PITTSBURG.

ITS HISTORY AND THE CORPORATE ORGANIZATION.

The Pittsburg correspondent of *Bradstreet's* writes as follows:

The councils of the city of Pittsburg have just passed a resolution that all action concerning the admission of more natural gas companies to the city shall be postponed until next spring. The laying of pipes in the streets will soon cease for the winter in accordance with the law in that regard. These facts give a breathing spell in the haste of events, which have been rushing on so impetuously of late in relation to natural gas as to defy deliberate examination.

There are but two companies authorized to lay pipes and convey natural gas within the limits of the city of Pittsburg. These are the Philadelphia Company, capital $5,000,000, and the Chartiers Valley Gas Company, capital $1,000,000. Others have been applying for permission to enter, and this action of the councils cuts off all hope of opposition to the existing companies during the winter. The sessions of the councils during the consideration of admitting other companies have been stormy, and the cry of "monopoly" has been freely used by the minority of that body. To understand the situation in this respect, it is necessary to take a brief glance at the history of the development of these companies.

The production and distribution of natural gas for mechanical purposes in western Pennsylvania has become a matter of national notoriety within the past few months. The benefits claimed to arise from its use, if well founded, make it as well a matter of national importance. Natural gas has been known ever since the earlier days of the production of petroleum by means of wells, a period of more than twenty-five years. Gas escaping from the ground was considered to be an evidence of the presence of oil, of itself of no more importance. Oil was the constant object of search, and, failing in finding that, the well was abandoned as a failure, irrespective of the fact whether it was a gas producer or not.

A few years afterward, these wells were utilized to some extent in the manufacture of lampblack, an industry which has been followed in the oil country for about sixteen years, and is still pursued. For many years natural gas has been in use as a fuel under boilers generating steam in the course of drilling wells; and the streets of many boroughs in the oil country have been illuminated by tall standpipes burning natural gas. It would be difficult to ascertain at this day to a reasonable certainty by whom or where these first uses of natural gas for heating and lighting purposes were made.

The pioneers in the piping of natural gas for mechanical purposes were an organization of prominent Pittsburg manufacturers and practical oil men, in which organization Captain C. W. Batchelor, for many years the president of the Masonic Bank and now the vice-president and the acting president of the Keystone Bank, was the moving spirit. He has been connected with the production of oil from the earliest days, and still interests himself in the development of new territory and enterprises connected with this class of mineral production. His organization was called the Natural Gas Company (Limited). It was organized in the summer of 1875, and the gas was turned into the line ten years ago this month of November. The members of this company were Graff, Bennett & Co., Spang, Chalfant & Co., J. J. Vandegrift, John Pitcairn, Jr., Henry Harley, W. K. Vandegrift, C. W. Batchelor—all names familiar to Pittsburg ears.

The opening of this line was a subject of ridicule by coal producers and manufactured gas men, and was altogether one of those new enterprises which have no friends except the few who had the courage of their own convictions sufficiently to invest their money in an undertaking not only new and untried, but pronounced utterly impracticable by persons claiming to be expert in the handling of gas. The wells were situated in Clinton township, Butler county, and the mills supplied were those of members of the firm, situated in Etna and Millvale, suburban boroughs of Pittsburg on the Allegheny River, and distant from the wells seventeen miles. The pressure of the first well was about 130 pounds. The opening of the line was conducted by Captain Batchelor and the superintendent with set watches, and the first fact ascertained was that the gas made its appearance in the furnace seventeen miles from the well in nineteen minutes through a six inch pipe. This was a triumph for the principle contended for, and those experts who had convened to laugh went away wiser men than they came; the gas had actually flowed of its own pressure through the length mentioned through a pipe which in places reached an elevation of 400 feet from the lowest levels of the line—undulations considered by many at that time to be fatal obstacles to success.

Although the material and appliances of this pioneer company were crude, the economy of the fuel was sufficient to excite opposition, and means of no creditable character were employed to bring the new fuel into disrepute. Among these was an ingenious device which was discovered by accident. The pipe was plugged with a six inch wooden plug twenty inches in length, through which a one and a half inch hole was bored. The evident design was not to cut off the gas entirely, but to show that a six inch main was entirely inadequate to supply the uses to which this was applied. By way of precaution, a gum ball was passed through the pipe from one end to the other, and in the course of the investigation no less than three of these plugs were discovered, which Captain Batchelor has still in his possession as curiosities of early opposition to the use of natural gas.

The analysis of this gas showed that it was about nine candle illuminating power, and its heating power about 25 per cent. in excess of that manufactured from Pittsburg coal. The company started with one well, and has had thirteen wells. It is still furnishing gas through its pipes to one of the mills mentioned above.

Their experience proves that the average life of a gas well in that district is from 3½ to 4 years. Their supply of gas being rather defective, it failed at times, rendering the use of coal necessary to keep the mills in operation, a circumstance that did not tend to remove the public doubts, which were assiduously fostered by parties adversely interested. Whatever views may be entertained of the success of these pioneer efforts, this was the first practical piping of natural gas by any company in the world for mechanical or manufacturing purposes. It was the only attempt on an extended scale until the development of the Murraysville district, which is situated about sixteen miles directly east of Pittsburg, in Westmoreland county.

The first well struck there was a "gusher," to use an expressive term in common use now. This well was struck in the year 1878 at a depth of 1,300 feet; and although one of the strongest flowing gas wells, its production has continued unabated ever since. Here, as formerly the object was oil. The obtaining of a gas well was a matter of no importance. It was not utilized until 1882, when Pew & Emerson put down pipes, and began to supply customers in Pittsburg. They formed the Penn Fuel Company, and about the same time the Fuel Gas Company of Alleghany county began operations looking also to the supply of Pittsburg customers from the Murraysville district, which has ever since continued to be the real center of gas supply.

As illustrating the little seriousness attached to the production of natural gas as an article of commercial value, until within the past few months, it may be remarked that nearly all the greatest gas producers have been deliberately set on fire for no other apparent purpose than to see how great a flame can be produced from a hole in the ground, and to get rid of the gas. For several months the country for miles around was illuminated by the McGuigan well in Washington county and the Westinghouse well at Homewood, within the limits of Pittsburg, struck as late as May 28, 1884, and was burning through the greater part of the summer of last year.

These companies, the Penn Fuel and the Fuel Gas, were chartered under the act of 1874, which was a general incorporating act. Gas companies first chartered in a municipality were endowed with an exclusive right to supply the public therein for a period of five years. The Fuel Gas Company was first chartered, although Pew & Emerson were first in the field. The Fuel Gas Company brought action, and secured an injunction against the Penn Fuel Company and Pew & Emerson from the Court of Common Pleas. This decision of the court was followed by a consolidation of the interests of the antagonistic companies, and natural gas corporations sprang up with amazing rapidity. To secure this exclusive right seemed to be the leading idea, and the records of the State show that from June, 1883, to June, 1885, a period of only two years, there were 232 natural gas corporations organized in western Pennsylvania, all located within less than a dozen counties. Every borough and township, some of them two or three times over, were covered by these enterprising paper-corporation makers. The publication of their names alone must have given people abroad a rather fallacious notion of the importance the natural gas business was assuming hereabouts.

Some of these speculative ventures had ridiculously small capital stocks; 44 were of $5,000 each; 61 of from $4,000 to $5,000; 83 of $1,000, and 14 of less than $1,000, 6 of which had a capital stock of only $130 each.

Notwithstanding the consolidation of the conflicting companies, there was influence brought to bear which secured an appeal from the decision to the Supreme Court, and in the latter part of 1884 this court of last resort reversed the Common Pleas on the ground that the act of 1874 referred to companies engaged in the manufacture of gas, and not to natural-gas companies. The exclusive right, therefore, did not exist, and the purpose of this dense cloud of little corporations utterly failed. The majority of them may be accounted among the things that were and are not except in name and memory.

This decision also left the commonwealth without any law applicable to natural gas, the production, distribution, and consumption of which had grown to considerable proportions. This was remedied by the legislature of 1885, which passed an act to provide for the incorporation and regulation of natural-gas companies, and approved May 29, 1885. Since then the business has taken a more legitimate and satisfactory form. It put an end to the purely speculative phase of the business of paper-corporation making, and it is fair to assume that any natural-gas corporation created since that date has some purpose looking to supplying gas to consumers, and the *prima facie* object is not to sell out to others, whatever its ulterior aims may be. Under that act exclusive powers are not granted, and this is expressly so stated, but there is also an express right for different companies to consolidate.

No company can enter a city and lay down its pipes without the consent of the councils and under such ordinances as may be passed for their regulation. The consolidation of Pew, Emerson & Co. (Limited), Penn Fuel Company, and the Fuel Gas Company of Allegheny county sold to an intermediary last summer, who sold their entire effect and franchises to the Philadelphia Company. This company also acquired by purchase the Acme Company and the Carpenter Company, with their respective plants and franchises. All these companies absorbed by it look to the Murraysville field for supply, but it has added wells and pipe-lines running to Tarentum, some twenty miles up the Allegheny River, and also at Homewood, within the city limits.

The plant of the Chartiers Valley Gas Company is not so large, and is not supplying an equal number of customers, but it is of no small importance. The Philadelphia Company controls about 40,000 acres of gas territory, and the Chartiers Valley Gas Company about 25,000 acres. There are other companies organized, producing gas, piping it to boroughs adjacent to Pittsburg and Allegheny, and have been knocking at the doors of councils for admission. Among these are the People's Gas Company, a new form of Pew & Emerson, the Manufacturers' Natural Gas Company, a new combination of the Fuel Gas Company. The arguments advanced for and against the admission of these new companies shed a flood of light on the situation, which otherwise might have been concealed.

Those advocating the admission of the new companies were urgent in presenting the evils of monopoly, while their opponents show that the investment of capital, already made to such an extent as to render the public benefit of cheaper fuel assured, is entitled to recognition; that prices are not high for the commodity, and that the public can be better served by one or two well-directed companies than by many indifferently directed companies; that the large capital already invested is ample security for safety in the conduct of the business, a consideration of no small importance in the distribution of such an explosive substance as natural gas is.

One of the singular features of the contest is that the *personnel* of the controversy have changed sides all around. When the Fuel Gas Company sought and obtained an injunction on the ground of exclusive right, the persons now interested in the Philadelphia Company were those who secured the taking of an appeal to the Supreme Court. The idea of a monopoly in a business of such importance to the manufacturing industries of a city of the size of Pittsburg was intolerable. Since they have absorbed all the leading companies based on the Murraysville territory, this exclusive right is, according to their view, the only real way to do the business. So long as the supply is ample at low rates, why should the pavements be torn up and the city kept in a chaotic condition at all times?

On the contrary, it will be seen that the Penn Fuel Company and the Gas Fuel Company, since selling out, no doubt at a handsome profit, to the Philadelphia Company, reorganize under new names, and seek to enter the city for the purpose of competition with those who bought and paid them for their respective plants. To them the monopoly which they sold out for large money has become an odious thing, one inimical to the public interests. Within a few months the monopolists have become anti-monopolists and the anti-monopolists have become monopolists in fact, if not in name. The present "monopolists," who defeated the original monopoly, have at present the advantage in the situation.

From the most reliable data obtainable, it appears that the total amount of pipe thus far laid is about 600 miles, of which the Philadelphia Company owns 340 miles, the remainder being distributed among the others. The pipes are from 6 to 24 inches in diameter. Within the city the Philadelphia Company has about 80 miles of mains laid, and has about 800 men constantly employed. The pipes from the wells range from 10 to 16 inch wrought iron, while those within the city are 20 to 24 inch mains, with a system of radiating 6, 8, 10, and 12 inch service pipes. The present supply of the city is from 50 wells, of which the Philadelphia Company owns 34, but there is a very large number drilled to near the gas-producing sand, ready to be "brought in" whenever there is any occasion for their use.

There are now about 1,500 private consumers, with more than that many applications on file, and preparations are being made to supply more than 10,000 dwellings.

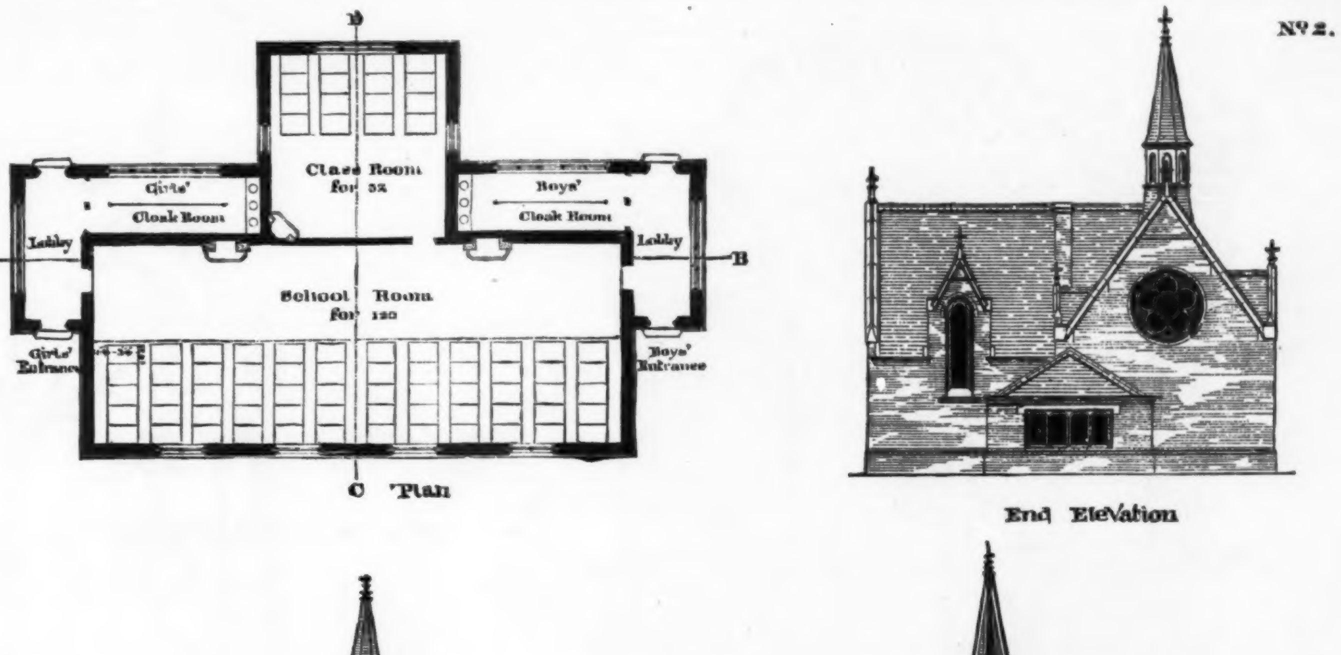
The Philadelphia Company, which began business late in October, 1884, and bought out the Penn Fuel Company and the Fuel Gas Company in June, 1885, has just declared the first dividend of 1 per cent. on its entire capital stock. Its profits are more than sufficient to pay that amount per month.

THE COMBUSTION OF EXPLOSIVE MIXTURES FORMED WITH COAL GAS.

M. DESAINS has recently presented to the Academie des Sciences a "Note" on the results of some further researches made by Mons. A. Witz on the subject of the combustion of explosive mixtures formed with coal gas. The exact knowledge we possess of the heat of combustion of this gas enables us to determine the temperatures and the theoretical explosive pressures of detonating mixtures made therewith. In the experiments now under notice, M. Witz found that a mixture of 1 volume of gas and 6 volumes of air gave with a constant volume a temperature of 2,064° C. and a pressure of 8·6 atmospheres, and with a constant pressure a temperature of 1,596° and 6·8 atmospheres; while a mixture of 1 volume of gas and 10 volumes of air gave with a constant volume a temperature of 1,514° and a pressure of 6·5 atmospheres, and with a constant pressure a temperature of 1,169° and 5·3 atmospheres. (The mixtures were taken at zero and at atmospheric pressure.) These figures are lower than those hitherto admitted; but M. Witz says they are justified theoretically, and are more in accordance with the results of experience. Operating with Manchester gas, Mr. Dugald Clerk was unable to obtain a higher pressure than 7·5 atmospheres, and M. Witz concludes that the difference of 1·1 atmospheres between his calculated pressure and the observed pressure of Mr. Clerk must be attributed to loss of heat caused by the sides of the cylinder, and not to dissociation, which does not take place at the temperatures indicated above. These temperatures (which were determined theoretically) explain the reason of our not observing in the cylinders of gas-engines those instantaneous deflagrations which give rise to the explosion wave discovered by MM. Berthelot and Vieille. The duration of the combustion is always appreciable, ranging between 0·045 and 0·468 of a second for mixtures similar to those in question. The period does not, however, depend merely upon the richness of the mixture, but upon the extent of the cylinder surface with which it comes in contact, and also of the agitation of the gas. The effect of slow expansion and great dilution, which retard combustion and render it incomplete, now becomes easily explicable, and it is this which causes a lowering of the coefficient of utilization. With regard to the speed of inflammation of the mixtures, M. Witz found that it was very much lower in the case of that which was the more largely diluted with air. He freely acknowledges that the conclusions he has arrived at are not entirely his own, but result from the remarkable discoveries of MM. Mallard and Le Chatelier and Berthelot and Vieille. The concordance of the results, however, obtained by means so diverse, support the theory of the action of the sides of the cylinder which he has sought to evolve from all his experiments. He considers that now he is in a position to affirm with more authority than hitherto that the cooling action of the cylinder influences to a very large extent the explosive phenomena utilized in gas-engines.

TESTING OF THERMOMETERS.

AT a recent meeting of the Physical Society, Mr. G. M. Whipple described and demonstrated experimentally the process of testing thermometers at and near the melting point of mercury, as carried on at Kew. About 20 lb. of mercury are poured into a wooden bowl and frozen by carbonic acid, snow, and ether; the mercury is stirred with a wooden stirrer, and the snow is added till the experimenter feels by the resistance to stirring that the mercury is freezing. The stirring is continued for some time, which causes the mercury to become granular instead of a solid mass. The thermometers are then inserted together with a standard, and compared. About 100 mercury or 40 spirit thermometers can be thus examined in half an hour, using about 200 gallons of carbonic acid gas, compressed sufficiently to form the snow. The bowl, ether, and mercury are cooled first to —10 deg. Cent. by an ordinary freezing mixture. The average correction at the melting point of mercury is now less than 1 deg. Fahr. When the process was introduced, in 1872, it amounted to 5 deg., but has steadily decreased.



DESIGN FOR VILLAGE SCHOOLS. (SCALE, 16 FT. TO THE INCH.)

A VILLAGE SCHOOL HOUSE.

WE illustrate a design for a village school by Mr. H. P. B. Downing, architect. These schools are intended to accommodate 150 children, and have separate entrances and cloak rooms for girls and boys. The building would be executed in red brick, with stone dressings, and covered with tiles or green slates. The estimated cost is $5,000.—*Build. and Eng. Times.*

THE Tucson *Citizen* suggests that the time is coming when Arizona cattle-raisers will sink artesian wells, irrigate the soil, raise alfalfa and grain, and raise finer cattle than now, when dependent upon scant pasturage. There is not a doubt but millions of acres of soil now regarded as worthless will be made productive by just such methods. Water is all that is required to make those desert and cactus lands blossom as the rose. Nature is proverbially careful of all her resources, and there is not a doubt but cool streams are running deep beneath these parched deserts of the West. In many places in California this has been demonstrated, and the purest and best of water has been reached, sufficient for every purpose.

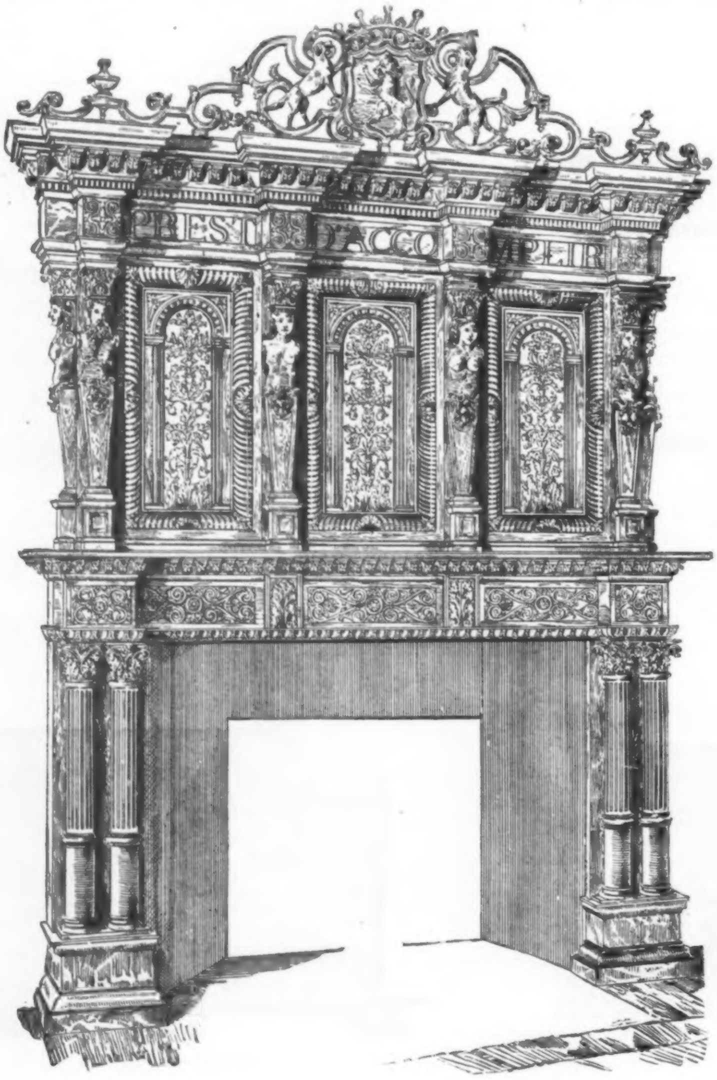
WELL IN THE COURTYARD OF THE HOTEL DE CLUNY, PARIS.

THIS is a characteristic piece of fifteenth century workmanship. The upper part, supporting the pulley, is entirely of wrought iron, the carved supports or brackets being brought over to a central pendant, and each of these is carried on a projecting little piece of metal, giving a sort of shoulder on the uprights above, which are two bolts firmly holding the parts together. The lower part of the structure is of stone, simply treated, with a curiously shaped projecting piece on the left-hand side of the capping ring of masonry; round this notched bracket the rope is fastened when not in use.

For the above and the illustration of the oak mantel piece we are indebted to *The Building News.*

OAK FIREPLACE AND MANTEL.

THIS example of an oak mantelpiece has been designed for the Earl of Shrewsbury by Mr. J. Birch, John Street, Adelphi. The whole is of oak, and above the mantel, which is divided into three panels, are caryatides. The panels between these are most elaborately carved with conventional foliage. The whole is surmounted by a characteristic cresting, in the center of which is the coat of arms and coronet, and below, on the frieze, the motto of the Earl of Shrewsbury (Prest d'accomplir), which, by the way, is badly divided, as only a portion of it comes in each panel. The mantel is supported on small brackets. Below this again, on each side, are two columns with Corinthian capitals. In the frieze which breaks round these is introduced the initial letter "S," in ornamental work, and the frieze has strap work, also ornamented with foliage. The whole is well and sharply carved, the modeling in the ornamental work being very good. It has been executed by the School of Art Woodcarving, who, we may mention, have some double doors and cresting for numerous bookcases for the library, in which this mantel is to be placed.



OAK MANTEL, INGESTRE HALL.

THE COLORING MATTER OF WINE AND VEGETABLE COLORING MATTERS.*

By M. TERREIL.

THE coloring matter of wine and the red coloring matters of plants are precipitated from their solutions under the influence of an excess of hydrochloric acid. The precipitation takes place even in the cold, but slowly, twenty-four to forty-eight hours being required for its completion, while at the temperature of boiling it takes place in a few minutes.

The coloring matter is always precipitated mixed with an insoluble ulmic matter, resulting from the action of the hydrochloric acid upon saccharine substances that occur in the juice of the plant. But the two substances can be easily separated by means of alcohol, which dissolves the coloring matter and leaves the ulmic matter undissolved.

In isolating the coloring matter by this method there is added to the juice or colored liquid its own volume of strong hydrochloric acid; the mixture is then heated to boiling, and kept at that temperature for about ten minutes. The precipitate that forms is thrown on a filter, washed with distilled water until the washings are no longer acid, and then left to dry. When the precipitate is dry, it is treated with 90° alcohol, which dissolves the coloring principle. The alcoholic solution is evaporated to dryness at a gentle heat in the presence of a small quantity of barium carbonate, intended to saturate any trace of hydrochloric acid that may be retained by the substance. The dry residue is afterward treated with hot water, which dissolves any barium chloride that may be formed; it is then again dried, and the coloring matter is redissolved in alcohol. This second alcoholic solution, when evaporated to dryness, leaves the coloring matter in a state of purity under the form of a red-brown varnish, which detaches readily from the capsule in small shining scales. The author has never seen it present any indications of crystallization.

Hydrochloric acid does not precipitate the whole of the coloring matter, it being slightly soluble in acids.

The coloring matter thus obtained is entirely insoluble in water; but it dissolves very freely in alcohol, to which it imparts a yellowish red-brown color. Acids change this to an intense red color; but alkalies turn it green, and it then passes rapidly to yellow-brown through absorption of oxygen from the air. Alkaline solutions, even when dilute, dissolve the coloring matter immediately, the solutions, which are at first greenish, passing rapidly to brown. Ether does not dissolve a trace of the coloring matter.

The red coloring matters contained in various wines, in the skins of black grapes and black or violet plums, in elderberries, gooseberries, raspberries and mulberries, in the petals of poppies, mallows, hollyhocks, and roses de Provins, etc., all present the same character after having been precipitated by hydrochloric acid; they dissolve in alkalies, the solutions being of a green color and turning brown rapidly by absorbing oxygen from the air.

The red coloring matters of the fruit of *Phytolacca decandra* and beet are not precipitated under the influence of hydrochloric acid. Under the action of boiling hydrochloric acid these red matters at first become brighter, then violet, and finally pass to yellow-brown without yielding any precipitate.

The red of Campeachy wood, red woods, and archil is precipitated by hydrochloric acid. The precipitate is rather soluble in boiling water. It presents the distinctive character of dissolving in dilute alkalies with a violet color, the solutions turning brown in contact with air.

Litmus gives with hydrochloric acid a not very abundant precipitate, an alcoholic solution of which is reddish. The precipitate dissolved in alkalies gives a fine blue solution which remains unaltered when exposed to air.

It would appear from the foregoing facts that there exist in plants several red coloring principles, which may be distinguished from one another by the following characters:

1. The red coloring matters that are precipitated under the influence of hydrochloric acid, and are soluble in alkalies, which color them *green.* This is the most numerous class.

2. The red coloring matters that are precipitated by hydrochloric acid, and are soluble in alkalies, which color them *violet.* In this class are to be found the reds of dye-woods and archil, as well as of cochineal.

3. The red coloring matters that are precipitated by hydrochloric acid and are soluble in alkalies, which color them *blue.* Litmus is, hitherto, the only substance that presents this character; there are, however, certain red or rose colored flowers, the colored juice of which becomes blue under the influence of ammonia.

4. The red coloring matters that hydrochloric acid alters without precipitating them, such as the red of *Phytolacca* and that of the beet.

In order to recognize quickly the nature of the red coloring matter contained in any vegetable substance, the author crushes the substance between leaves of unsized paper, so as to cause the colored juice to stain the paper, and then exposes it to ammonia vapor, under the influence of which the color is changed to green, violet, or blue. Operating in this way he has ascertained the changes in color that the juices of the following plants undergo when exposed to ammoniacal vapor:

Rose	changes to	bright green.
Cherry laurel	"	bright yellow green.
Dark violet Marguerite	"	dark green.
Fuchsia, violet petals	"	green.
" sepals	"	azure blue.
Geranium	"	blue with greenish tinge.
Pomegranate flower	"	violet-blue.

WELL IN THE COURTYARD OF THE HOTEL DE CLUNY, PARIS.

In examining the coloring matter of wine, the author heats about 5 c. c. so as to drive off the alcohol, then adds an equal volume of hydrochloric acid, and boils the mixture. After two or three minutes' boiling the liquid is thrown upon a small filter, and the red-brown precipitate produced is washed with distilled water; the filter is then crushed between unsized paper, and afterward opened out and exposed, still moist, above a flask containing ammonia. If the matter on the filter turns green, it is assumed that the coloring matter has been derived from the grape, or from a vegetable substance containing the same coloring principle as the grape; but at present it is impossible to say with certainty what substance has yielded the color.

Submitted to elementary analysis, the coloring matters of wine and of Campeachy wood precipitated by hydrochloric acid, and the ulmic matter precipitated at the same time as the coloring principles, have presented nearly the same centesimal composition, as will be seen from the following figures:

	Coloring of wine.	Coloring of Campeachy.	Ulmic matter.
C	55·63	56·27	56·70
H	5·50	4·68	4·73
O	38·37	39·05	38·57

THE THREE SOURCES OF PROSPERITY.—"There are three things which make a nation great and prosperous—a fertile soil, busy workshops, and easy conveyance of men and things from place to place."—*Lord Bacon.*

* *L'Union Pharmaceutique* for August, from the *Bulletin de la Societe Chimique.*—*Pharmaceutical Journal.*

TY-TO-MAEN, ST. MELLONS, NEAR CARDIFF.

THIS house is now being erected from designs by Mr. E. M. Bruce Vaughan, architect, of Cardiff, for Mr. Richard Allen, of the firm of Messrs. Shiller and Co. The walls are built with a native stone found near the site, of a pink tint, and the dressings are being executed in Westwood Ground Bath stone. The roof is to be covered with green slates from the Whitland quarries. The work is not let to a contractor, but is being built by day work, under the supervision of the architect.—*Building News.*

PRISON LABOR.

OWING chiefly to the agitation of the Knights of Labor, who are sworn to resist the competition of free with prison labor, and whose influence is very great among all organizations of workmen, a number of States, including New York and Illinois, have recently abandoned the contract system for supplying employment to convicts. It has been estimated, but we know not how competently, that it will take New York three years to readjust her penal system in the institutions at Sing Sing, Auburn, and Clinton to the new prohibition, and that it will cost the State $5,000,000 in that time to maintain those institutions, which a twelvemonth ago had just achieved self-support. On the usually accepted estimate of the cost of supporting a prisoner, at $200 a year, it would only require $1,800,000 to maintain the convicts of New York in idleness for this time. Between the selfish desire of the tax-payer to shift this burden from his estates to the prisons themselves, and the moral feeling that the 3,000 delinquents who are in durance for their depredations upon society ought not to be rewarded by living at the expense of the community for a term of years, this repeal has seemed to many a foolish business, and workingmen have been charged with entertaining the worst sentiment of the communistic spirit, namely, that which would enforce a distribution of wealth by making property bear needless burdens that the proletariat may be the more prosperous.

It has been argued that the proportion of convicts to the free laboring population is so small (it was one in 1,000 in Pennsylvania a few years since, including county jails and work-house) that their industry can have no appreciable effect upon wages, and that the agitation of the workingmen arises more from a sentiment than from any real grievance. Those who use this argument have surely forgotten their lessons in the elements of political economy. Because the prisoner is freed from the necessity of self-maintenance his labor is not subject to the usual law of supply and demand, and almost invariably, when not incarcerated, he is not one of the producing class. Convict labor, therefore, creates that small margin of surplus which affects the whole range of prices. If it were ascertained that the wheat product of the country was in excess of all demands, even only one bushel in a thousand, the fall in price would not be one mill in the dollar, but fifty or hundred times that amount. So were there the same ratio of ascertained scarcity, the rise in prices would be at a greatly enhanced rate.

It must also be remembered that the competition is not between the convict and the whole body of laborers. He never comes into collision, for example, with agriculture in America. From the nature of the case the contractor converges the labor of hundreds of convicts upon a single industry like shoe making or chair making, and there the competition becomes much more severe. On this subject Mr. Richard Vaux, long a director of the Eastern Penitentiary of Pennsylvania, said before the Eighth Annual Conference of Charities: "But two or three trades can be profitably carried on in any prison, and of these each prisoner can learn but a small portion, the purpose of making a profit out of his labor requiring the utmost division of work. The product of prison labor thus cheaply produced competes on unfair terms with the products of honest outside labor."

In the popular mind it has been considered a great achievement to make a prison pay its own way. But the success of that measure is not always presented by the prison bookkeeper's balance sheet. The saving to the community here may be more than counterbalanced by the cost of police, the administration of justice, and the existence of a class withdrawn from productive activity and predatory in their habits—all of these fostered if not created by a prison arrangement which returns to society a body of unreformed or incorrigible men. Speaking of a bad system of incarceration, Mr. George L. Harrison writes: "The wrong reacts upon the wrong doer, and the pernicious system of injustice costs more than the generous remedy. It turns out here, as it always will, that the course of humanity and right is the cheapest in the end."

So far as selling the time of convicts to contractors is concerned, the best penologists of the country and of the civilized world are in accord with the demands of the Knights of Labor. However different their motives, their economical conclusion is the same. While the workman objects that he does not wish his own toil to be put in competition with a system by which a few conveniently located employers can place their savings in wages to the account of the state, the penologist objects because the contract creates interests wholly inconsistent with the reformatory discipline of the prison. Said a former president of the Pennsylvania State Board of Charities, himself a decided supporter of the theory that convict labor should be productive as far as was compatible with reformatory treatment: "Nothing has led to greater deterioration of prison discipline, corruption of the prison-keepers, and demoralization of the prisoners, than this system of contract labor, wherever it has been adopted. It completely annuls the idea of reformation as an object of prison labor, and makes it merely a means of petty pecuniary profit or pecuniary relief to the state (in which it sometimes signally fails) and of untold and irresponsible oppressions and cruelties on the part of the interested and unfeeling overseers and drivers. The labor should be performed under the eye and control of responsible parties who have no selfish ends to accomplish by it, and who will take a humane and personal interest in the welfare and amendment of the convicts."

There are few students of penology anywhere who will not rejoice in the sweeping away of the whole contract system, and in its permanent exclusion from our punitive institutions, because it is a vital and perhaps a first step in bringing their administration into a wholesome and promising state. It is a curious fact that several of the best movements for improving prisons began in the United States, only to be efficiently adopted abroad, while in many of our American States but little has been accomplished. The separate cell system, which was authorized in Pennsylvania as early as 1790, and which remains among American prisons the distinctive feature of the Eastern Penitentiary of that State alone, became the model of the Pentonville prison in England, and its plan has been adopted in Belgium, Holland, Baden, Bavaria, and other European states. The scheme of congresses for the discussion of penological questions is nowhere less influential in affecting legislation than in America. The reasons probably are that we have thirty-eight separate legislatures to influence, and these in turn are so amenable to the popular will that there must first come a wide comprehension of these intricate and delicate questions before any judicious plan can be adopted. Were a national prison to be established for the confinement of convicts in the United States courts, and put under a competent commission, the example of such an efficient institution would react upon the various States.

Let it be accepted as a principle of prison discipline that the purpose thereof is the amendment of the criminal, and that the place of labor in that scheme is to further this end, and the perplexities of the subject begin measurably to clear away. It is now fifty-six years since the Eastern Penitentiary of Pennsylvania was completed. During all the time, through good or civil report, the managers have consistently maintained its peculiarities, and almost without exception each generation of managers have become the enthusiastic friends of its policy. Without touching upon the superiority of solitary confinement over the congregate plan, it is enough for this article to say that the institution has not paid its way, nor is it expected to; all the inmates are kept at such work as can be done by individuals working separately, such as stocking weaving, shoemaking, etc.; the product is not controlled by contractors, and there is little or no opposition made to its influence on the labor market. Each convict has allotted to him a certain daily task, not so arduous but that with diligence he can easily exceed it. What he does in excess of this task is credited to him to form a fund either to ameliorate the bareness of prison accommodations under the rules of the institution, to aid in the support of his family, or to line his pockets on his discharge.

If labor is an essential element of all reformatory discipline—and no plan has been proposed which lacks it—then another misconception must be removed. At present it stands in the law as a penal feature. To be sentenced to hard labor is theoretically an aggravation of punishment, where the judge makes it part of his sentence that it is held to be something severer; that a simple order of incarceration, although imprisonment without labor, is in reality the more degrading and the harsher of the two. This in itself is an indignity to labor, making it the badge of disgrace. In fact, it is the way out of disgrace—the means of transforming a worthless into a useful and reputable life. To apply this idea to the prison system, work should be regarded as one of the privileges of the discipline, and the higher the skill required for its performance the greater should be the privilege. This doctrine leads at once to something very much akin to the famous Crofton or Irish system, the results of which have been found to be admirable. In that there are three prisons, or rather grades of imprisonment, since one is nothing like a jail at all. The first one is situated in Dublin, and thither the convict goes to pass the first eight or nine months of his sentence. Here he is confined in a separate cell upon a coarse diet, and engaged in the most unskilled and hard employment, usually oakum picking. Here, too, he is taught that his future depends entirely on his own deportment, and how to conduct himself to get the best results of his situation. From the Mountjoy prison at Dublin he goes to Queenstown harbor, where on Spike Island is a prison for congregate labor, in which the inmates are divided into four classes, each of which represents an upward stage in deportment and usefulness. From Spike Island the transition is to Lusk, near Dublin, where the convict finishes his confinement. There are no bolts nor bars here, only an open farm—no police, no prison costume. The custodian of the prisoners works with them. Practically, they present no other aspect than hired men working on a farm. Here they are discharged on tickets of leave, requiring them to report statedly to the constabulary, a part of their sentence having been remitted in proportion to their good behavior.—*Bradstreet's.*

TY-TO-MAEN · ST MELLONS · NEAR CARDIFF · THE · RESIDENCE · OF · RICHARD · ALLEN · E^{SQ} · E M · BRUCE · VAUGHAN · ARIBA · ARCHITECT

THEATER SECRETS.

EVERYTHING on earth has its light and its dark sides, and likewise the appearance of a theater from in front of and from behind the curtain is totally different. That which produces the most wonderful effects when seen from the boxes and the parquet seats seems almost ridiculous when viewed from the rear part of the stage.

The mechanism required for shifting and changing the scenes, moving the slides, operating the traps, etc., is quite complicated, but at the same time very primitive. In fact, no improvements of any importance have been made during the last century in theatrical machinery, and the chief mechanical contrivance used is the pulley, of which great numbers are used on the different scenes, frames, etc. The parts are held together by gimlets screwed through one frame and into another. The only improvements made in stage machinery and scene frames consists in making some of them of metal, thereby making them lighter and more durable.

Attempts have been made to shift the scenes, operate the traps, and perform other like operations by means of water power, but after a short trial all these experiments had to be abandoned. It was found to be cheaper and surer to place a number of men at each machine, or at other parts to be moved or shifted, as so many movements are required in a theater, and are required but for so a short time, that it would be not only impracticable, but also expensive, to provide the machinery and make the complicated connections.

The only great improvement in theater scenery has been made in the Madison Square Theater, New York city, which is constructed with a double stage, and, while the performance is being carried on, on one stage, the scene is being set on the other.

In the annexed cuts, taken from "Ueber Land und Meer," some of the stage machinery in common use is shown. A trap is well known, and consists of a platform which is raised and lowered by means of windlasses. The Rhein Daughters in Wagner's opera "Rheingold" are supported by skeleton frames on standards mounted on cars which are moved by stage hands. The enchanted book is operated by means of cords by a supernumerary behind the scenes, as shown in our cut. In the opera of "Don Juan," the monument of the *Gubernador* bears the inscription, "Here revenge awaits the murderer." The moment that Don Juan appears in front of the monument, one of the stage hands removes a strip from behind the transparent inscription, which now appears in brilliant letters on the base of the monument. In the opera "Freischutz," an army of demons and ghosts passes over the stage, and the hissing, snapping, screeching, and other hideous noises are produced by means of whips, clappers, whistles, rattles, and other like devices behind the scenes. In the "Sicilian Vespers," the gondolas are represented as gliding over the stage, and the manner in which they are propelled and in which they are constructed is clearly shown in the annexed cut. Some other stage effects require more complicated and elaborate machinery, but in almost all cases the means employed resemble those described.

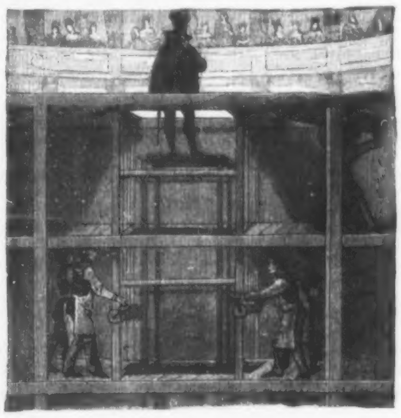


FIG. 1.—TRAP IN THE STAGE.

FIG. 2.—THE GONDOLAS IN THE OPERA "SICILIAN VESPERS."

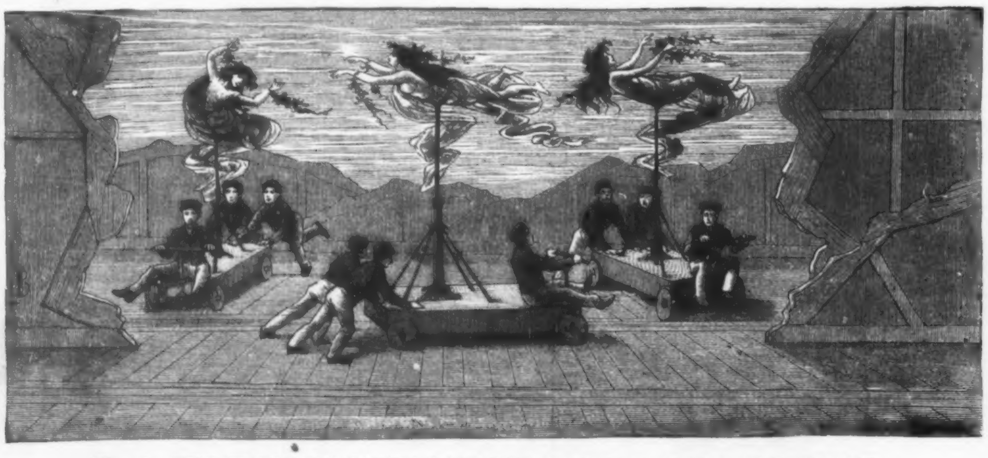


FIG. 3. THE FLOATING RHEIN DAUGHTERS IN THE OPERA "RHEINGOLD."

FIG. 4.—THE ENCHANTED BOOK IN THE OPERA "HANS HEILIG."

FIG. 5.—THE GRAVEYARD SCENE IN THE OPERA "DON JUAN."

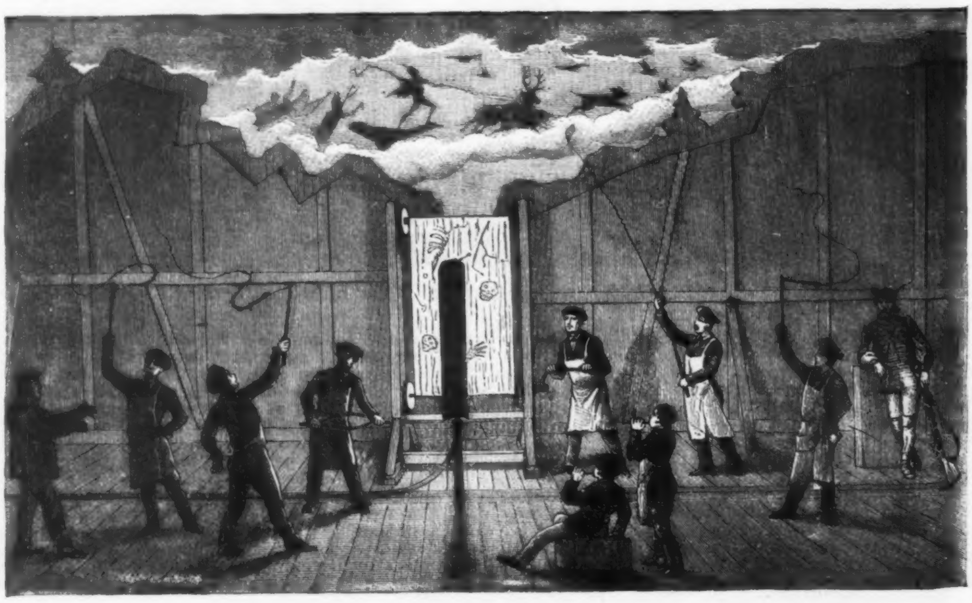


FIG. 6.—THE APPARITIONS IN THE OPERA "FREISCHUTZ."

MR. G. A. BOTSFORD, of Frederickton, N. B., recently undertook to sink a shaft on his lands, with a view to working a bed of clay. He had not progressed very far downward when he struck a ledge of graphite which has proved to be of good quality, and the mine of considerable valuable.

STRENGTH AND DEXTERITY.

THE feats which are performed by certain individuals who seem to us to be endowed with extraordinary strength, and which elicit our surprise and admiration, are often due in great part to dexterity and a proper use of power that sometimes is not greater than that possessed by other men. The importance of the *role* of dexterity is daily shown among laborers. A skillful workman will do more effective work with less expenditure of strength and less fatigue than another workman who has equal or even greater physical strength, but who does not know how to utilize it. As regards athletes, this influence of dexterity was shown and demonstrated experimentally as far back as the beginning of the last century by the celebrated English physiologist, Dr. Desaguliers, who made a study of the processes used by athletes and acrobats in their exercises.

The doctor's studies of athletes were made upon an individual who was exhibiting at London, and whose feats were extraordinary. It was a man named Eckeberg, who was born in Anhalt, and who traveled throughout Europe under the name of Samson. He was a man of medium height and well proportioned, but exhibited nothing remarkable in his muscular development. Dr. Desaguliers, after observing him several times subsequent to seeing him perform his feats, was persuaded that these latter were rather the result of dexterity than of strength, and, after some little practice, found himself able to repeat most of the exercises of the German athlete. One day, in fact, while making a communication to the Royal Society upon this subject, he performed a series of these feats of dexterity before that learned assembly. The following are descriptions of a few of these, taken from his memoirs. A man having attached to his belt a strong

rope that is fixed to a post, and then having placed his two feet against the latter, breaks the rope by a simple action of the extensor muscles, and then falls upon a mattress placed under him for the purpose (Fig. 2).

A man resists the strength of four, five, or six persons, or even of one or two horses. Such resistance depends only upon the position assumed by the experimenter. The latter has the loins encircled by a leather belt, to which is attached the rope by means of which an endeavor is made to budge him. The rope passes through a hole in a board against which the athlete braces his feet. This board is vertical, while the per-

FIG. 1.

former sits upon a horizontal or slightly inclined one (Fig. 2). In this position the resistance of the bones and muscles of the legs and pelvis is enormous, and is capable of supporting a powerful traction.

In another experiment, the individual stands upon a platform, and a rope attached to his belt passes through an aperture between his feet. This rope is attached to a platform upon which are placed barrels of water, stones, or a cannon. When the supports that hold the lower platform are removed, the man sustains the latter and its heavy load for a few instants (Fig. 2).

According to Desaguliers, a man whose head and feet are resting upon chairs, and whose body is thus suspended horizontally in space, can in such a position support one, two, three, or more individuals upon his breast (Fig. 2).

In another experiment, a man stands upon the knees of the athlete, who is lying upon his back, and who gradually bends so as to raise his knees. Then, seizing the ankles of the man standing upon him, and bending back a little, he straightens himself by a sudden movement, and his body, leaving the ground, takes a horizontal position nearly on a level with the knees. A man of medium strength can in this way, with a little dexterity and practice, support not only one individual, but six, eight, or ten.

Such are the principal experiments on strength and dexterity described by Desaguliers.

FIG. 3.—FEMALE GYMNAST DESCENDING A ROPE.

Some athletes bend an iron bar half an inch or an inch thick by striking it against their arm. After a dozen blows, they succeed in bending it nearly at right angles. Afterward, by striking it in the opposite direction, they straighten it again. This feat has been performed at Moler's circus by a young amateur, Mr. De Saint M., who is endowed with such strength that he is capable of measuring himself successfully with any professional athlete whatever.

In order to bend an iron bar in this way, it is naturally necessary to possess splendid physical force, and, besides this, to have certain skill.

The bar, which is about a yard in length, being held by one extremity with the right hand, meets the left arm covered with thick leather.

As the bar touches the arm at about the lower third of its (the bar's) length, it results that its entire upper extremity, owing to the impulse given it, acts with such leverage as to double the force that tends to bend it. When the blow given by the athlete is equal to a pressure of twenty-two pounds, for example, the force that tends to bend the bar exceeds forty-four pounds. It is due to this little mechanical calculation that athletes succeed in performing a feat that at first sight seems so extraordinary.

The feats of strength executed by means of the jaw likewise require a certain dexterity.

Some acrobats suspend themselves from a trapeze or rope by means of a piece of leather that they hold in the mouth, while others support a cannon; but the most remarkable feat of this nature that has ever been observed is now being performed by an athlete at Paris. This man is of medium height, and possesses muscles which, while not exhibiting a remarkable development, are yet very conspicuous. After carrying forty-four-pound weights, and performing the traditional feats with dumb-bells, he places a barrel with a man astride of it, and forty-four-pound weights upon it, on a frame. Then, seizing the chine with his jaws, he

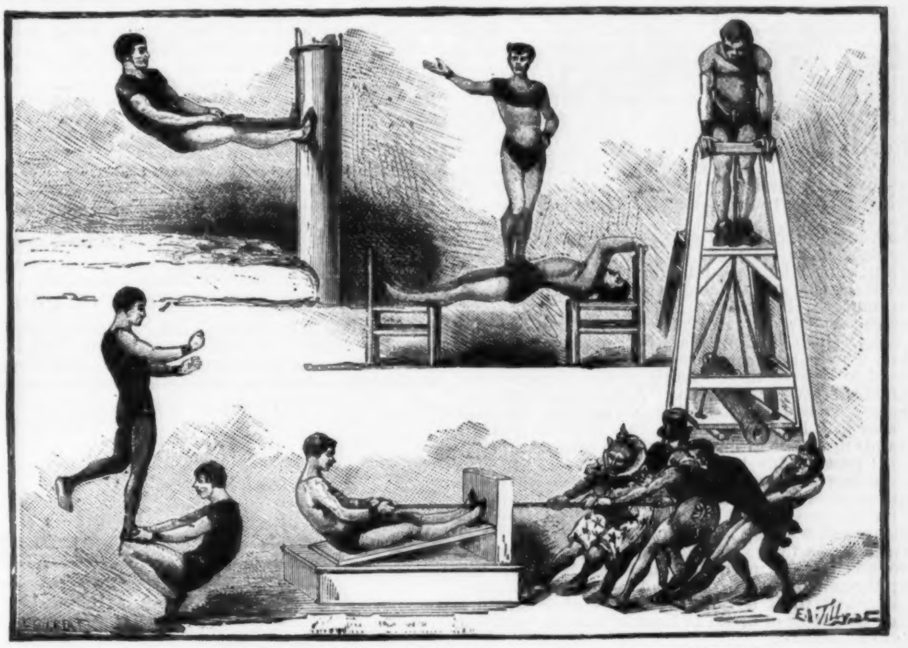


FIG. 2.—EXPERIMENTS ON STRENGTH AND DEXTERITY.

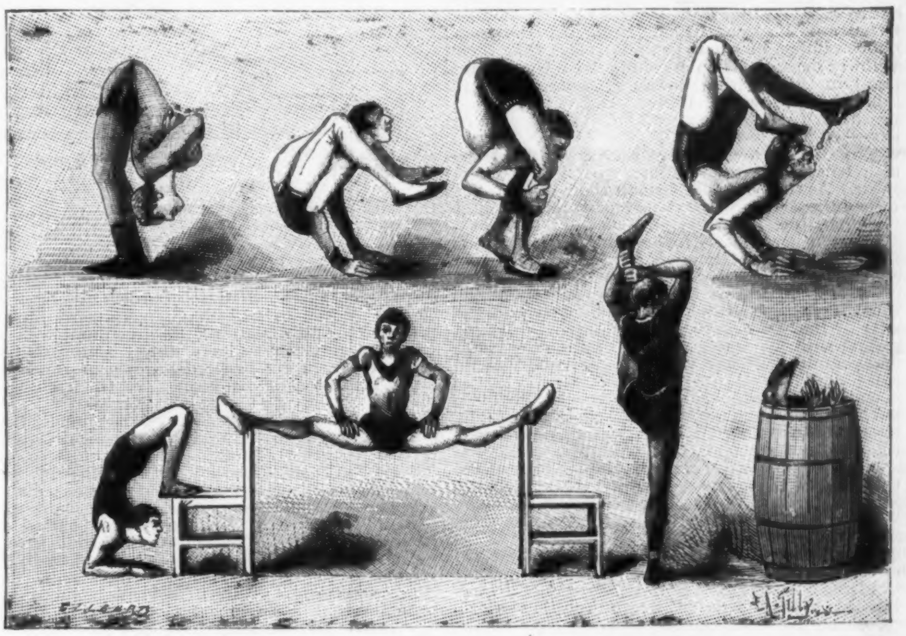


FIG. 4.—VARIOUS EXERCISES OF CONTORTIONISTS.

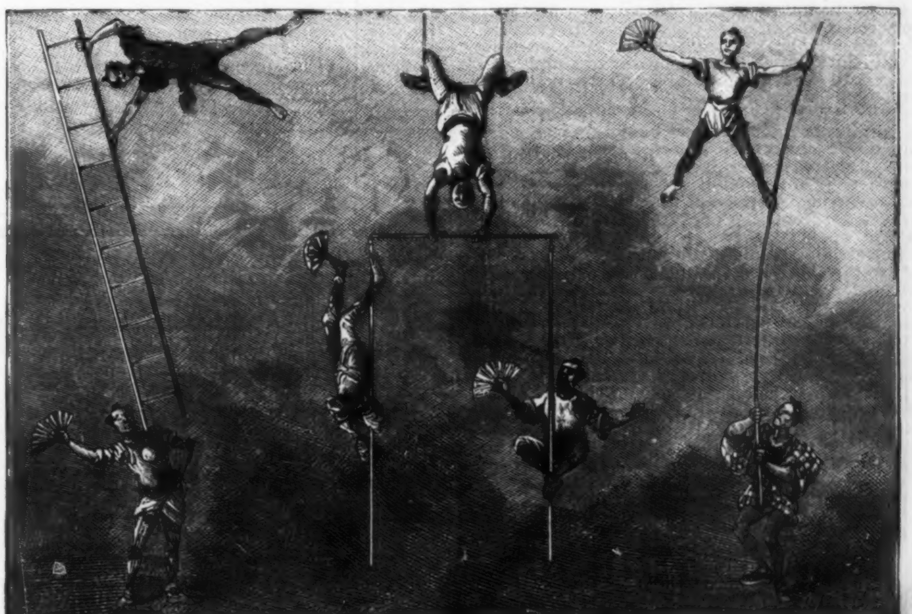


FIG. 5.—JAPANESE PERFORMERS.

bends backward and holds this enormous load in the air for a few instants (Fig. 1).

Buffon says: "Man does not know his strength, he knows not what he loses by laziness and inactivity, and he is ignorant of what he might gain through diligent work and long exercise."

This remark of the learned philosopher finds its demonstration in the exercises of contortionists and gymnasts. With those who do not exercise the body continuously, the joints finally come to operate less freely, and refuse to execute such motions as do not enter into the category of those that they have been daily accustomed to perform. On another hand, the muscles refuse to stretch to any extent if they have lost the habit of doing so. If an individual in whom this state of things exists wishes to perform a feat in gymnastics, pick up an object from the ground, or bring his arms together behind his back, all his joints, ligaments, and muscles immediately resist, protest, and give way only at the cost of more or less intense pain. But, if his organs be very frequently exercised, they will become accustomed to execute motions which were new to them, and which they at first resisted. Then the joints gradually yield, the ligaments become pliable, and the muscles become elongated and developed.

The human body is, in fact, susceptible of acquiring a suppleness, an elasticity, and an agility such that acrobats, contortionists, and gymnasts seem to possess different organs, and to have joints that are comparatively new to the spectator. Among the principal exercises performed by acrobats of this kind, we may cite those repeated nightly at the Summer Circus by Savina, who makes such a use of his body that one is tempted to believe in the truth of the surname that the handbills give him, *i. e.*, the "Anatomical Mystery."

These exercises are as follows: Touching his back and loins with his head, and in this position putting his hands upon the ground so as to be bent completely double; passing his head between his legs; passing his shoulders between his legs; rising upon his hands and placing his feet under his armpits, on his shoulders, and on his head; and throwing his legs over his shoulders and walking in this position (Fig. 4).

In this same figure, the acrobat who is eating with his foot is resting upon his hands, his body and legs being thrown over his head, and one of his heels having attached to it a fork, by means of which he is picking up pieces of bread in front of him and carrying them to his mouth.

All these series of experiments is based upon the flexibility of the vertebral column. The coxo-femoral articulation, when sufficiently supple, permits the acrobat to execute other feats, such as placing his legs upon the same horizontal line. Being seated upon a table, for example, he can so extend his legs that their entire lower part shall be in contact with the surface of it, and, in this position, he can wind one of his legs around his body taken as a center. And so, too, resting his legs upon two chairs, he can sit in space with his legs extended horizontally.

Every one has seen an acrobat seat himself on the top of a barrel, and then suddenly bend double and disappear. As the barrel is of small diameter, it forms a genuine tube that requires the acrobat inclosed in it to be bent completely double, and each leg to be in a state of extension, that is to say, the thigh and leg must be upon the same line. Now, this complete extension of the lower limb, while the body is inclined toward it, is very painful. It is the extension of the articulation of the knee and ham that constitutes the difficulty of that exercise which consists in touching the ground with the hand without bending the hams, or in picking up a piece of money under such circumstances.

The feats of gymnasts are no less curious. We often see two or three young persons perform the most difficult evolutions upon one or more trapezes placed at a great height, and we behold them jump a distance of seven, eight, or ten yards from one trapeze to another, and that, too, with so much ease and safety that the seated spectator who is looking at them is almost ready to believe that it is very easy to turn somersaults from one trapeze to another.

The manner in which gymnasts reach their apparatus at the top of the theater or circus, and the way they descend from it, is also to be considered. Some of them are hoisted up by means of a rope running over a pulley, either by workmen or by their own hands, while others climb up a cord with their feet and hands. These latter display a remarkable example of strength, since, at every bend of the arm, the stress exceeds from 130 to 150 pounds, and is repeated ten, fifteen, and twenty times, according to the height of the trapeze.

The descent of the gymnast presents the same variety; one will allow himself to drop into a net simply, while another will slide down a rope. There is a young female gymnast who slides down slowly, and very gracefully. With one of her legs wound round a rope held taut by assistants, and her body thrown back, she comes down slowly with graceful poses, waving two flags, and decreasing or increasing her speed by the pressure solely of her muscles against the rope (Fig. 3).

Certain gymnasts present the peculiarity of using their feet as prehensile organs, after the manner of monkeys, which they rival as regards agility, and imitate in a striking manner. Japanese gymnasts especially excel in this respect. One of these, it will be remembered, exhibited a few years ago under the name of the "man monkey." Clothed in a costume adapted to his role, this person climed up a pole, fastened himself to a rope by his feet, swung backward and forward, skipped about, turned somersaults, and, in a word, performed a multitude of exercises as well as, if not better than, a real monkey could have done. A Japanese troop that exhibited in 1884 in the various circuses and theaters of Paris likewise performed some wonderful feats, and the gymnasts that composed it used their naked feet with great skill. Among the performances of these men, the most remarkable were the following:

The Bamboo Exercise.—A bamboo rod five or six yards in length was balanced vertically, its base resting upon the belt of one of the performers. Up this rod climbed a bare-armed twelve year old boy in a picturesque costume. In order to climb the rod, he seized it between his first and second toes and mounted hand over hand. Upon reaching the top, he performed several tricks. Thus, resting one foot upon the rod and seizing the upper part of the latter with one hand, he remained suspended in space, his body forming an X. After this, taking the rod in his slightly separated hands, he stretched his body out horizontally. Then he suspended himself by his feet, head downward, and allowed himself to slide down in this strange posture.

In the *Broken Ladder Exercise*, the same young gymnast began his exercises upon a ladder balanced vertically by another Japanese, who placed one of the uprights alternately in his belt or upon his shoulder. All at once the ladder separated into two, one of the uprights and the rounds fell upon the ground, and upon the other upright the gymnast continued his exercises.

Let us cite still another performance of these Japanese acrobats. One of them, suspended from a trapeze by his hands, held a rod from which hung two other rods, and, upon these latter, two gymnasts performed precisely the same evolutions. At a certain moment, being at the top of the rods, and in a sitting position, they suddenly allowed themselves to slide downward, and, when they reached the lower extremity, stopped themselves, just at the moment a fall seemed imminent, by a simple contraction of the muscles—by a simple pressure exerted between one of their hands and the sole of the other foot. It will be recalled, however, that one day at the Folies-Bergere one of them could not stop himself in time, and fell upon a young lady, whom he severely injured, although he himself was not harmed.—*La Nature.*

CORRESPONDENCE BY MEANS OF PIGEONS.

THE mode of correspondence by pigeons, which has been frequently practiced from ancient times for civil and military purposes, and which has been taken up in modern times, has, especially since the war of 1870, been an object of attention on the part of the great European powers, and we may say that it has now received an organization that borders upon perfection. It is only just to add that governments have been preceded in this direction by a large number of private societies, whose efforts have largely contributed to the laying down of the principles that now prevail in the establishment of pigeon houses and the training of the birds.

Intelligence of Pigeons.—As yet, the faculty that permits these birds to find their quarters again after being carried to great distances is not precisely known. "Some," says Mr. Tassandier, "attribute it to instinct; but this word, which is devoid of sense, contains a simple confession of ignorance. Others claim that the pigeon is endowed with a sensitiveness that we cannot form the least idea of, and that permits it to guide itself according to the differences in density of the various strata of air through which it is passing. Finally, others assert that the bird's memory is extraordinary, that it recognizes the least objects that it has seen on the earth's surface, and that this faculty, in conjunction with sharpness of sight, permits it to find guiding points in the country that it is traversing."

It is possible, moreover, as regards the memory of the pigeon, to cite some remarkable facts. Thus, for example, in some experiments performed in Germany in 1878, some of these birds returned to their cote after being separated from it for four weeks, and others again, after being shut up at Essegg and Olmutz for six weeks, also reached home. A still more striking example was observed at the end of the war of 1870-71, when, after five months' of exile, some pigeons made the passage from Port de Pile (Vienna) to Paris (a distance of 180 miles) in a day and a half, in midwinter and through a show-clad country. But, for want of more numerous experiments, we are tempted to regard these facts, and especially the last mentioned, as exceptions. Moreover, memory would not suffice for these messengers, when they had been carried in a basket and in a closed wagon from one station to another. This same objection applies to the use of the sight, and obliges us to attribute the success of the dispatchers, at least in great part, to the sensitiveness with which the pigeon (like all birds) is to a high degree endowed. It is probable, then, that it is to these faculties as a whole—directive instinct, sight, memory, sensitiveness—singularly developed in the best subjects by training and selection, that carrier pigeons owe the valuable aptitude that has been utilized for so long a time for aerial correspondence.

As for the causes that set these special faculties in operation, we recognize two prominent ones—the quest of food and well being, and parental instinct. It is, in fact, upon these two bases that is founded the art of training. When communication by pigeons was being established between Paris and Versailles, at the time of the National Assembly, care was taken to shut the pigeons up successively for a few months in one or the other of these places, in order that they might contract domestic ties. Then water was banished from one of the cotes and food from the other, and birds got in the habit of flying from one cote to another in order to eat or drink. This method was afterward tried with the same success between Saint Petersburg and Krasnoe-Selo.

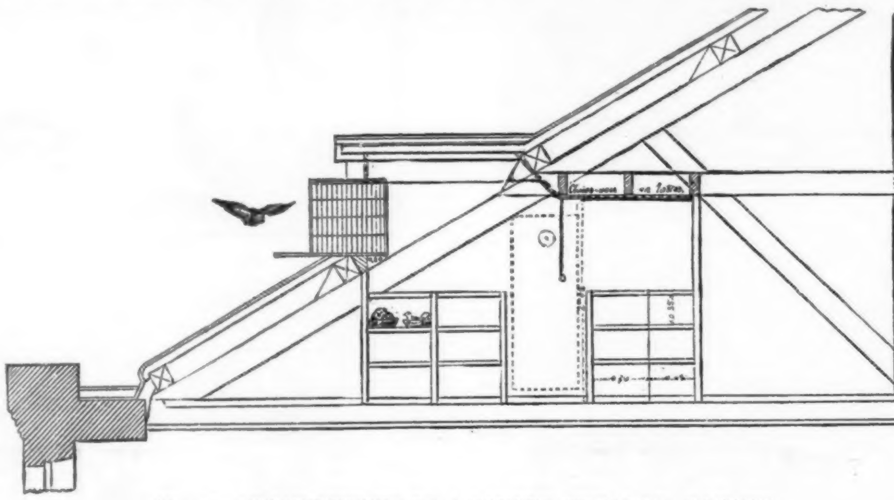


FIG. 1.—ARRANGEMENT OF A PIGEON COTE IN A GARRET.

Parental instinct, moreover, is very strong in the pigeon, and it is well known that the couples are generally faithful, that the male relieves the female on the nest, and that each couple, after selecting a compartment, only abandons it in its own defense and after bloody war upon the invader.

Races Preferred.—The most esteemed breeds, and the only ones now employed in Europe for military purposes, are those of Belgium, comprising three varieties—the "Anversian," "Liegian," and "Mixed."

"The Liegian pigeon," says Mr. La Perre de Roo, "is distinguished from the other types by its delicate form and by the ruffled feathers, which, after the manner of a maw, deck its breast and give it a coquettish and *distingué* look. It has a small and very short bill, ornamented at the base with white and but slightly developed caruncles. Its eyes, which are bright and prominent, are surrounded by a small white, fleshy ring, and shine like rubies. Its head is convex, as in all Belgian carrier pigeons, which rarely have the depressed one of the English bird. It has a short neck, which is provided with numerous small, long, and narrow feathers having metallic reflections. Its wings are very long, and rest, through their extremity, upon a narrow tail composed of twelve rectrices, which are so superposed as to make the tail but one feather wide.

"The Liegian pigeon enjoys a well merited reputation in Belgium, and, as regards its elegance and instinct, has nothing to envy in the other varieties.

"The Anversian carrier pigeon differs from the foregoing principally in its large size, and in its bill, which is longer. Its broad breast, and the wide spread of its

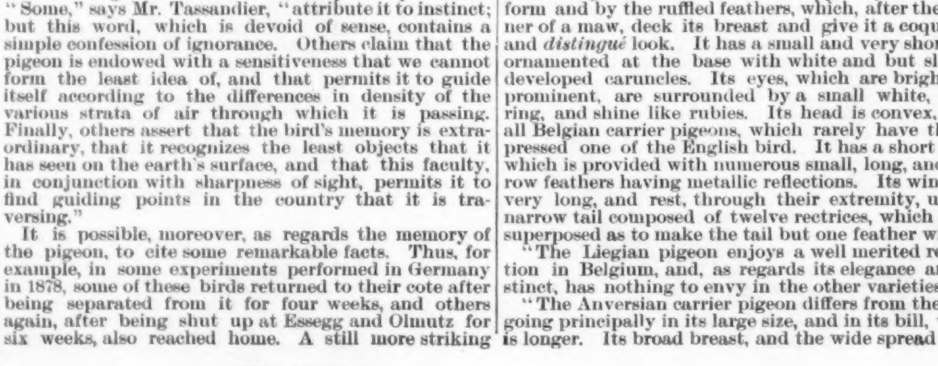


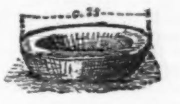
FIG. 2.—ARRANGEMENT OF A PIGEON COTE IN AN UPPER STORY.

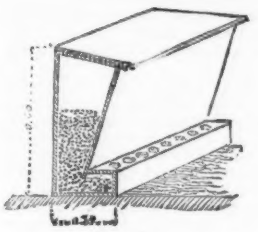
wings, the remiges of which extend to the extremity of the tail, are characteristics of a powerful and sustained flight.

"This pigeon is particularly distinguished by its resistance to fatigue during voyages of great length. Its convex head, wide between the eyes, detaches itself from a strong neck amply supplied with feathers of a silky appearance, and its narrow tail gives it the stamp of the true carrier pigeon of the ancients."

Arrangement of the Pigeon Cotes.—A pigeon cote must be dry, well ventilated, placed in a proper direction, and be protected against rodents. Dryness, which is indispensable, in order to prevent dung from adhering to the birds' feet, is obtained by using for flooring either flagging or beton, and spreading a layer of sand over it. Ventilation is effected by means of

FIG. 3.





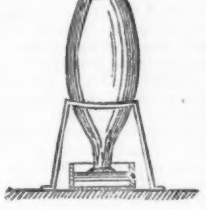


FIG. 4. FIG. 5.

FIG. 3.—PLASTER NEST. FIG. 4.—FOOD RECEPTACLE. FIG. 5.—DRINKING TROUGH.

currents of air passing through all parts of the space occupied. The exposure varies according to the country, but it must always be such as to prevent the entrance of rain to as great a degree as possible. Finally, as a protection against rats in buildings constructed especially as pigeon houses, the floor is placed about 16 feet above the earth, and the posts are surrounded at their upper part with tin or sheet iron guards. When a pigeon cote is constructed in an already existing building, the destruction of the noxious animals must be effected by the usual processes, and the doors and sills must be provided externally with a band of sheet iron.

The places usually selected are the garrets of houses or the upper stories of military or civil structures. They must not be so high that they shall serve as a target

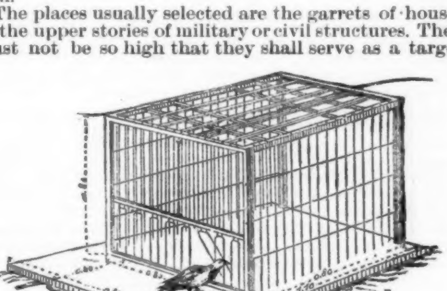


FIG. 6.—CAGE.

for the enemy's projectiles in places where war is going on, or that they cannot be easily reached by the person whose duty it is to take care of them. Figs. 1 and 2 show the arrangement of a pigeon cote in a garret and in an upper story. It is agreed that the normal number of couples that each apartment should contain must not exceed 40 or 50. Pigeon cotes comprise essentially: (1) two closed compartments for holding the pigeons kept as messengers—one being set apart for males and the other for females, in order to prevent coupling, as this may prevent their return to the cote whence they were taken; and (2) a certain number of compartments for the pigeons hatched out in the cote or brought thither when young, each of them capable of being exclusively reserved for birds designed to be dispatched in a given direction. In certain cases there may be

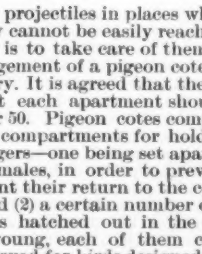


FIG. 7.—WICKETS.

added a compartment for isolating sick birds, and also one for those designed for breeding; but the first is rarely used, for fear of epidemics.

The compartments are 2¼ feet in length by 1½ feet deep and 1¼ in height—dimensions sufficient to allow two broods to be sheltered, the couples frequently having a second brood before the first has been reared.

Each couple occupies a compartment especially reserved for it. There are usually three tiers of these compartments, but never more than four, so that the attendant can watch them and easily take the pigeons out. The compartments are very simple in structure, and are made of boards ½ an inch thick. Each compartment receives two nests, which are made of plaster, so that they can be kept very clean (Fig. 3). The compartment likewise contains a food trough (Fig. 4), so arranged that the grain descends only in measure as that below is eaten, and a drinking trough (Fig. 5), whose pointed apex prevents the birds from perching upon it and thus soiling it and the water.

For the sake of easier inspection, the compartments are usually arranged at the two sides of the same corridor, although they may, without inconvenience, be placed in a line with one another. The doors are 5½ feet in height by 2½ in width, with a sill 7½ inches in height, and are provided with a strip of sheet iron or zinc that comes into contact with a similar strip, so as to prevent the entrance of rodents.

In order that the pigeons may be readily caught when wanted, and to prevent them from getting wounded in their efforts to escape, the height of the cotes is limited to 6½ or 7 feet by a thin lath partition that forms a ceiling, and offers no obstacle to ventilation (Figs. 1 and 2). For the same reason, care is taken, where the cote is located under a sharp angled roof, to close the angle with a board partition.

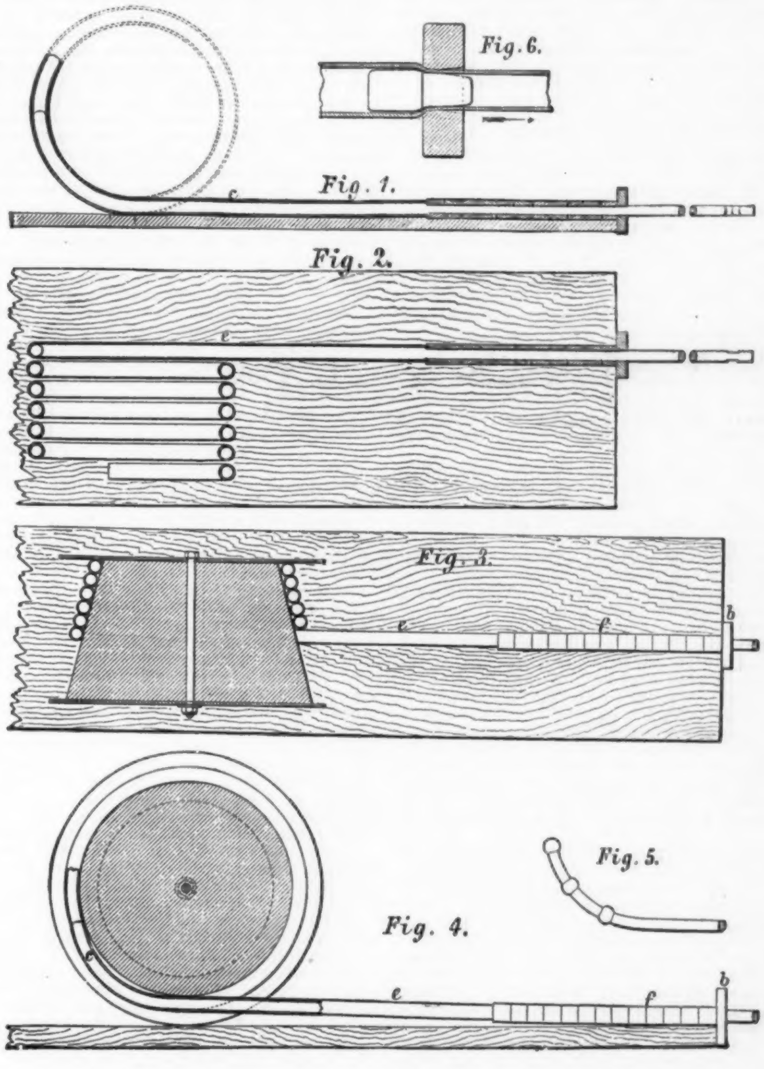
The pigeons enter and make their exit through a cage whose dimensions and arrangement are given in Fig. 6. The sides of this are closed by a grating, while the back is open, and the front is closed by a sliding door provided with wickets (Fig. 7), so that the bird can enter by pushing the latter, but cannot get out on account of their bearing against a sill. When it is desired to let the birds out, it is only necessary to raise the wickets. This cage (in which the carriers are taken) is placed in a dormer window or in a window of the upper story (according to the location of the cote), in such a way as to project 8 inches internally and 16 externally, and be at a height of 4¼ feet above the floor. The open space around the cage is closed with a trellis of laths.—*Le Genie Civil.*

COILING METAL TUBES AT THE INVENTIONS EXHIBITION, LONDON.

A STAND in the North Gallery of the Middle Court caught the eye by the fine collection of coiled copper tubes it displayed. These, says *Engineering*, were the manufacture of Muntz's Metal Company, Limited, of Smethwick, and derived an additional interest from the fact that they were produced by a new process, invented by Mr. T. Budworth Sharp, also of Smethwick. The ordinary method of bending copper pipes to helical or spiral form is to fill the straight length with resin, lead, or sand to prevent it from becoming flattened under treatment, and then to coil it upon a drum of the appropriate shape. After the pipe has received the required figure, the core is melted or shaken out as far as possible; but when it is of resin or lead, a portion of it always remains to contaminate the liquid when the coil is employed as a condenser. The pipes shown at the Exhibition were, however, perfectly clean and bright inside, for they were bent on a metal mandrel a trifle larger than themselves, so that in passing through them it acted as a die to draw and polish the interior surface. The method of manufacture is herewith illustrated. A straight length of pipe, which is usually 70 ft. long, is laid on a drawbench, and has inserted into it a solid mandrel, *e*, rather less in diameter than itself, and curved at the end for about 90 deg. to the desired radius of the coil. The curved portion may be of a slightly larger diameter than the interior of the pipe, or it may be enlarged in places (Fig. 5), to draw the interior surface. The other end of the tube does not rest directly against the drawback of the drawbench, but some loose tubular packing pieces are interposed between the two, so that the pipe may be coiled up to its extremity. The mandrel passes through the drawback, and is connected to the drawing apparatus, by which it is forcibly moved forward through the tube, while the latter is held stationary at one end. At the other end, however, the tube is obliged to curl up to allow the passage of the curved core through it, the result being that, as the mandrel advances, the pipe is bent into a helix which rolls itself along the bench until it finally slips off the end of the core, and is complete.

When the coil is to be an involute, the apparatus is somewhat modified. The arrangement of the tube, mandrel, and drawback is the same as before, but the bench is made very narrow, its width being only equal to the diameter of the pipe. The tube, instead of being allowed to form its own figure, is wound on a drum with deep flanges. The length of this drum is only equal to the diameter of the pipe, so, when one convolution has been laid upon it, the second is obliged to mount upon the first, the third on the second, and so on, the drum rolling meanwhile along the bench, and being guided by its flanges. The body of the drum is of a spiral form, so that the second convolution is led over the first without any sudden bend. In making a conical coil, the drum is of the form shown in Figs. 3 and 4. As the tube, *e*, is coiled on the drum by the action of the curved end, *c*, of the mandrel, which is bent to the smallest radius of the coil, the drum rolls along the bench, and in addition to its rolling motion has a motion at right angles to the direction of the tube being coiled. The packing pieces, *f*, and the drawback, *b*, are the same as in the previous arrangements. By the use of other drums different figures can be produced, the drums being capable of being taken to pieces when required.

Another improvement, introduced by Mr. Sharp into the manufacture of tubes, is shown in Fig. 6. In the ordinary process of producing copper tubes the exterior is reduced in diameter by a drawplate, while the interior is supported by a cylindrical, or nearly cylindrical, mandrel, which travels with the tube: or the interior of the tube is supported at the point where the drawing takes place by a bulb fixed in the eye of the drawplate by a long rod extending backward through the tube. In place of this bulb or mandrel, Mr. Sharp uses a short plug of hardened steel, the fore being of the diameter it is intended the interior of the tubes shall be after it is drawn, and the rear part of a diameter not less than the smallest part of the die or drawplate. The fore end of the tube under treatment has its diameter reduced in the usual way to enable it to be inserted in the die; the plug is then inserted from the opposite extremity, and pushed up to the contracted part. The tube is then drawn as ordinarily, the plug fixing itself in the position shown, and the tube traveling over it. These two inventions, although exceedingly simple, are of the greatest value in the manufacture of pipes, and raise a wonder how it was that they were not produced years ago. They form another example of the truth that simple processes are far more difficult of attainment than the more complicated.



SHARP'S PROCESS OF COILING METAL TUBES.

[Continued from SUPPLEMENT, No. 521, page 8319.]

THE AMERICAN PUBLIC HEALTH ASSOCIATION

ON PHYSICAL TRAINING IN GERMANY.

IN the evening session, Dr. E. M Hartwell of Johns Hopkins University read a paper on "Physical Training in Germany," in which he described the system of "turning" and turn-vereins. In German schools, gymnastics are now compulsory for both boys and girls, and none are excused without a physician's certificate stating that it would be injurious to them. In 1882 only ten per cent. were thus excused. Two hours in each week are devoted to physical training.

This system has developed in Germany within one hundred years. In 1793 the first classical work on gymnastics was published by Gutsmuth. Jahn, called the father of "turning," was born in 1778 and died in 1852.

In 1842 the King of Prussia declared turning to be an indispensable part of the education of male youth.

In 1860 it was made obligatory in public schools, and within three or four years in schools for girls also.

Parallel and horizontal bars and other gymnastic apparatus were invented by the "turners," and introduced in America.

School turning has followed the line marked out by Spies, viz., "free turning," that is, without apparatus.

There are over one hundred gymnasia in Berlin and a thousand teachers capable of giving instruction in gymnastics. Pupils come from all parts of Germany. Large sums of money are annually appropriated to defray expenses of physical education.

Even in a city the size of Frankfort on the Rhine are thirty-one turnhalle. In addition to two hours a week for physical training, two hours a week are set aside for compulsory play. Fencing and swimming are commonly taught.

Soldiers are drilled in gymnastic exercises, and become so expert as to be able to get over a brick wall 20 ft. high or an iron picket 15 ft. high without apparatus and without tearing their clothing.

The introduction of gymnastics in America dates from 1825, when a school was opened at Round Hill with several German teachers.

ON DISINFECTION OF SEWERS.

Dr. O. W. Wight, health officer of Detroit, Mich., gave a graphic and amusing account of experiences in disinfecting the sewers of that city. In the alarm caused by the spread of cholera in Europe last year, the common council appropriated $20,000 to clean the city. The sewer system is among the worst. There is no regular system, but a score of great conduits four to eight feet wide, and two to seven miles long, submerged at their mouth for 500 to 1,000 feet, and many of them choked with saw logs. The sewers thus plugged up become receptacles for sewer gas.

The work of disinfecting began by throwing twelve pounds of copperas into each receptacle; 75,000 pounds of copperas were used by the health commissioners, and arrangements were made by which a wholesale dealer supplied citizens at one cent a pound. Ten cents had previously been charged. It was computed that they bought 20,000 pounds.

To destroy foul air and kill the fungous growths that accumulate on the sides and top of the sewers, it is necessary to use a gaseous disinfectant. For this purpose sulphurous acid gas was employed. Three tons of roll brimstone were purchased. Sulphur was burned in pails let down in every manhole. Some was found still burning after the lapse of twenty-four hours.

A great abatement of diphtheria and almost complete cessation of scarlet fever followed. They used to have a thousand cases of diphtheria in a year. The whole expense of disinfection was less than $1,300.

In the ensuing discussion, Dr. Raymond, health officer of Brooklyn, stated that he preferred chloride of lime to disinfect sewers in the typhoid fever district, but so much water constantly flows as to dilute the chloride below the disinfecting strength within the distance of a single block after it was put in. Citizens actually made it a ground of complaint that the smell of the chloride got from the sewers into their houses, not realizing how this fact emphasized the necessity of using it. The disinfection of sewers is, however, only a temporary expedient.

In response to a query, Dr. Wight stated that the diminution of disease was at one time in the month of June, and at another in the months of August and September. As regards the fungi in sewers, it was very probable that most of them were harmless, and perhaps some even acted as scavengers, but, in adopting general measures, it was impossible to so discriminate as to destroy the bad and save the good. The wheat and the tares must go together. The poisonous fungi very probably have developed from the innocuous; thus cholera bacillus is not unlikely to be a poisonous variation of an innocent saprophyte; and the same might be said of yellow fever, just as in the case of the bitter and sweet almond.

Dr. Rohe suggested that scarlet fever and diphtheria always decrease in summer, hence it would be more satisfactory if Dr. Wight's experiments should be repeated in winter.

ACCOUNT OF THE PLYMOUTH EPIDEMIC.

Dr. Benjamin Lee, Secretary of the State Board of Health, then read a paper on "The Debit and Credit Account of the Plymouth Epidemic." This was an epidemic of typhoid which raged during last spring and summer at Plymouth, Luzerne County, Pa. It was distinctly traceable to the dejecta of David Jones, who contracted typhoid in a visit to Philadelphia, and, returning home, his fæces were thrown out near his mountain residence, and allowed to accumulate and freeze during the winter. On the advent of spring, the first thaw poured them into a stream which supplies the village with water; and soon after the first warm day, the disease appeared suddenly in all parts of the village. There were in all 1,104 cases of typhoid which could be distinctly traced to the drinking of this polluted water, of which 713 cases occurred in April, 261 in May, 83 in June, 31 in July, 15 in August, and one in September. There were in all during this period, including a few cases not directly traced to the water, 1,150 cases and 114 deaths. No record of equal accuracy exists for so large an epidemic of typhoid in so limited an area. Such was the debit side of the account. The credit side was that out of this epidemic was born the Pennsylvania State Board of Health.

ON MARITIME SANITATION AND QUARANTINE.

Thursday morning was devoted to the consideration of the general subject of maritime sanitation and quarantine. Dr. John H. Rauch, Secretary of the State Board of Health of Illinois, read a paper on "Maritime Sanitation from the Mouth of the St. Lawrence to the Rio Grande." The cholera, he says, is still to be warded off; hence our whole coast line must be carefully guarded. Commencing with Texas, he gave a detailed account of the sanitary precautions all along the coast. The Texas coast line covers 500 miles. There are stations at six ports of entry. Yellow fever is the disease most dreaded. The old system of quarantine, which consisted merely in detaining the vessel, might only enhance the peril, since the yellow fever germs thus have time to multiply, and the cargo becomes more dangerous after ten days' delay that at first, as does the vessel itself. Disinfection is the only proper and adequate remedy, and may be resorted to without unreasonably detaining the vessel. It is difficult to quarantine the Rio Grande.

Proceeding to Louisiana, he said that the quarantine of New Orleans is now the most effective ever secured in this country, if not in the world. The disinfectants used are bichloride of mercury and sulphurous acid gas. Vessels from yellow fever ports are quarantined from three to five days. From 150 to 300 pounds of sulphur are used on each vessel, and the gas penetrates into every part of the cargo. The expense of disinfecting is reduced, by obviating the necessity of lightening the cargo, from $1,500 to $1,800 to $1.

The methods of other ports along the coast were then described. Of New York he said that small-pox had been detected on several vessels coming here, and 2,000 passengers had been detained at quarantine during the year.

At Boston, all vessels arriving from June to November, except from certain near-by ports, are inspected. There is a storehouse for disinfecting rags by sulphurous acid. Steam disinfection is also provided for. Access of cholera is not likely to occur at Boston.

Of Canada he said that the Grosse Isle Station was for a long time the most important quarantine station in the country. Over 15,000 victims of cholera and small-pox lie buried there. With the advent of ocean steamers, this station has lost its importance. Cholera was introduced into this country *via* the St. Lawrence in 1832. Various improvements in the Canadian stations were suggested.

Dr. Montezambert, health officer of Quebec, replied that many of Dr. Rauch's suggestions had been already anticipated, and the others would be attended to.

Dr. Joseph Holt, President of the State Board of Health of Louisiana, read a paper on "Sanitary Protection of New Orleans, Municipal and Maritime." He said that maritime sanitation has taken the place of quarantine at New Orleans, an acknowledgment of the germ theory. Bichloride of mercury is the best disinfectant for cholera and yellow fever. The addition of a little indigo to the solution will warn any person against drinking it. The surest prevention of a fire is to quench the first spark; the surest prevention of an epidemic, to kill the first germ. Last January at New Orleans, with a population three times as large as usual, small-pox broke out at nine distinct foci, and in every instance was confined to the room where it originated. This was done by dipping everything in the room in a solution of bichloride of mercury before it was allowed to leave.

Ships arriving from yellow fever ports were treated as follows (some of the details being taken from a private exposition of methods afterward made by Dr. Holt): An apparatus has been devised consisting of nine furnaces, each seven inches high, arranged in three rows of three furnaces each, one above the other. In these furnaces sulphur is burned, and a blaze is blown over them by a Sturtevant revolving planing-mill fan, capable of three thousand revolutions per minute. This blows the current of sulphurous acid through a tube a foot in diameter, consisting of galvanized iron, with connecting tube of asbestos cloth, into the bottom of the hold. All the hatches having been closed, except a small opening in the other end of the ship, the entire hold is filled with gas, which is forced into and out from every nook and cranny, and even blows out from the masts to the very top, as if the ship was on fire. After the air has all been changed, the velocity of the fan is decreased so that the hold may be filled up with sulphurous acid, giving time for nearly all the oxygen of the air to be taken up as it passes over the burning sulphur in furnaces. About two hours is sufficient to disinfect the ship. With steamers a different course is taken. The gas is forced into the bottom of each compartment separately, and allowed to ooze out as it can.

The baggage of all the passengers is taken ashore and opened out, and then all sprayed with solution of bichloride of mercury, one part in one thousand of water, and the clothing and other baggage is then dried, allowing the solution to dry in. Lately, a steam drying chamber has been imported from Troy, such as is there used in the laundries, but larger, being 50 feet long. By the use of this, the necessity of saturating silks and velvets with moisture and thus ruining them is obviated. Only the coarse articles are now sprayed, and then all are brought together in the drying chamber and heated to a temperature of 350° F. The water in the coarse fabrics makes an atmosphere of superheated steam, in which all are thoroughly disinfected, and come out neatly dried and ready for use.

Dr. Holt proceeded to say that Carwona, the head of the sanitary service in Mexico, and Friere, in Brazil, agree that the inoculation of yellow fever is practicable, producing a mild form of the disease, and rendering the patients proof against a subsequent attack. The main object of his visit to Washington was to urge upon the Association and on Congress the appointment of a commission to investigate this subject. He offered the following resolutions, which were adopted the next day, having been favorably reported by the Executive Committee:

Whereas, The question of immunity from yellow fever is so intimately connected with the social, industrial, and commercial growth of Tennessee, the Southern Atlantic and the Gulf States of the Union as to determine the destiny of Memphis, Charleston, Savannah, Pensacola, Mobile, New Orleans, and Galveston; and

Whereas, A large, accumulating mass of testimony that the power of protecting the unacclimated against yellow fever has been discovered and proved in the inoculation of the essential germ or cause of the disease, by methods distinctly formulated and available, these aforesaid declarations and numerous instances cited in corroboration emanating from medical scientists at the head of the biological departments in the highest institutions of learning in Mexico and Brazil, authorized by and bearing the indorsement of their several governments;

Resolved, That we, the representatives of the Boards of Health in the several States of the Union, and we, the officers and members of the American Public Health Association, regarding the question as pre-eminently a vital issue, as one, in its assumptions, true or false, and, if true, of incalculable worth, surpassing the computation of many millions of dollars, and to the saving of tens of thousands of lives of our own people, that we hereby petition and urge upon both branches of Congress, now assembled, to appoint a commission for the purpose of making a complete investigation of, and reporting, after a thorough examination of the methods pursued, their effectiveness in protecting the unacclimated against the yellow fever infection, together with all associated observations and experiments that may be ascertained.

Resolved, That the commission stated in the aforesaid petition shall consist of three persons, one of whom shall be of known ability and special attainment in biological research, particularly in the department of microscopic investigation and culture of the essential germ as causative of the infectious and contagious diseases. The other two members of the commission shall be medical men of recognized ability, based upon long and ample experience, competent to give expert consideration to all phases of the symptoms and course of yellow fever in any form wherein the phenomena of the disease may present themselves, whether induced in the course of pestilential invasion or in purposely devised inoculation.

Resolved, That this commission aforesaid shall proceed at the earliest possible moment to Rio de Janeiro as the first field of its labors. Having completed there its work, it shall proceed to Mexico, and, if necessary in the accumulation of testimony, to Panama, Colon, and Havana.

Resolved, That the sum of $30,000, or so much thereof as may be actually required to pay the necessary and unavoidable traveling and other expenses and the salaries of the members of this commission, be appropriated.

Resolved, That the sum of $5,000 shall be paid as a recompense to each member of the aforesaid commission.

Dr. S. T. Armstrong of the United States Marine Hospital service at Memphis, Tenn., read a paper on "Maritime Sanitation." He proposed a number of salutary reforms, such as proper examination of seamen before starting on a voyage; plenty of space for breathing in the berths; wholesome food; sufficient clothing; disinfection of vessel with bichloride of mercury, which should be used to flush out the bilges. Superheated steam may be used between decks to destroy yellow fever germs. Cold will not destroy them. He condemned the practice, which seems to be a "fetich" with sailors, of drenching down the deck with water.

In the ensuing discussion, Dr. Smith, health officer of New York, stated that the New York quarantine had long been one of measures, not of time. It has been a quarantine of sanitation, and has lifted the burden of delay from commerce. He was surprised that Southern ports had not long ago adopted it.

A resolution was adopted, requesting the Commissioner of Statistics and Labor to appoint a commissioner to examine the sanitary condition of factories and workshops.

(To be continued.)

NITRO-GLYCERIN A SUBSTITUTE FOR ALCOHOLIC REMEDIES.

By JOSEPH B. BURROUGHS, M.D., Manchester, N. Y.

SEVERAL years ago, while using glonoine in a case of angina pectoris, and watching its wonderful stimulating properties over the heart and general circulation, the idea occurred to me that it might in many cases be employed where the use of alcohol would seem a necessity; in fact, to substitute it for alcoholic remedies in the treatment of many diseases. At first I was unwilling to rely wholly upon it in severe cases, but as I became more acquainted with its effects I realized we possessed in it a heart stimulant far superior to alcohol: 1st, in the minute quantity required, one to two drops of a one per cent. solution being equal to an ounce or more of brandy; 2d, it is tasteless, colorless, and nearly odorless; 3d, rapidity of its effects; 4th, and greatest of all, in that there is no possibility of creating an appetite for stimulants.

Alcohol, in its effects on the body, is classed with chloroform and ether. All three produce first a period of excitement, followed by a stage of unconsciousness. In chloroform and ether the stage of unconsciousness is soon reached, hence they are used to produce this result. With alcohol the first stage is of longer duration, and the second stage is not reached unless large quantities are taken, hence it is used principally for its stimulating effect on the heart and general circulation. Nitro-glycerin, possessing in a more marked degree this same stimulating power, may be used whenever this result is desired by the physician, and brandy would seem imperative. I have found it of great value in nausea and faintness during minor surgical operations, severe case of laudanum poisoning, headache in anæmic patient, hysterical aphonia, asthma, to prevent *petit mal*, collapse in typhoid fever, shock after an accident, and many others where a stimulant was indicated.

The following are some of the more marked cases of its beneficial effect, where brandy might have been used:

Opium Poisoning.—CASE I.—Elderly lady by mistake swallowed a large quantity of laudanum. In fifteen to twenty minutes, at which time I arrived, she was unconscious, jaws firmly set, respiration very feeble (do not remember how many), pulse at the wrist hardly discernible, and later not to be felt save in the carotids;

body and limbs growing cold. By means of hypodermic injections of atropine solution the respirations were increased in strength, but the heart continued to grow more feeble. I discovered the lady possessed mitral insufficiency—of twelve years' standing as I afterward learned—which accounted for the alarming effect of the opium. Repeated hypodermic injections of brandy were then resorted to, but with no change in the pulse. After four hours I dropped between her parted lips three drops of a one per cent. solution of glonoine, the largest amount I ever gave for a first dose. In less than fifteen minutes the pulse at the wrist was bounding, full, and regular. In less than an hour more she was drinking strong coffee, and answering "yes" and "no" to questions put to her.

CASES II. and III.—*Hysterical aphonia* in a man of 40 and a woman of 28; are so near alike, a description of one will answer for both. Woman, married, is suddenly attacked with terrible pain and pressure over heart. Respiration becomes very rapid, sixty to eighty, and shallow, pulse feeble, and forty to eighty, every muscle rigid, unable to speak. Usually remains in this condition for hours, as she did the first time I saw her. The second time I was called I dropped one drop of glonoine between her lips, and in ten to fifteen minutes heart was beating full and strong, thus relieving the engorged lungs; the respiration became deep and strong; all other symptoms quickly disappeared.

CASE IV. was somewhat similar, except pulse was 200 (I counted the pulsations by dotting a paper with a pencil for every beat for a minute, and then counting the dots), respiration not so short, but rather a sense of suffocation. Glonoine had the same effect as in Cases II. and III.

CASE V.—Collapse of typhoid fever. The fever, after a severe course, left on the twenty-third day; after a week of convalescence, the patient was attacked with persistent hiccough. Next day his fever returned, ran rapidly up to 104·5°, when he vomited and purged large quantities of bile. For a time he was wild, but changed to low muttering; pulse became very feeble and remittent. Ordered brandy and milk, but the first teaspoonful he took he spit it out with a cry that "he was on fire," and refused to take any more. I then gave small doses of glonoine, often repeated, which, with other remedies, restored him to his former condition in a day or so, and ultimately to health.

Hardly a day but I use it where brandy might be given. Thus in a recent case, a young man nearly tore two fingers from his hand while at work. While dressing it he became so faint and nauseated I had to cease. Here brandy or ammonia was certainly the thing to use, but *one* drop of nitro-glycerin in a few minutes sent the blood rushing to his head, and I finished my task with no further trouble.

If nitro-glycerin proves a substitute for alcohol, as physicians may soon prove for themselves, the profession may become more thorough advocates of total abstinence than heretofore, as many have felt that, in some cases at least, spirits were a necessity.—*Therapeutic Gazette.*

OBSERVATIONS ON THE MUSKRAT.*

By AMOS W. BUTLER.

THE muskrat (*Fiber zibethicus* Cuv.) is very abundant in most localities in Southeastern Indiana. In local distribution it varies in numbers according to the abundance of water and favorable localities for its increase. From all that I can learn, I do not think it is less common than at the time of the early settlement of this region.

These animals soon became acquainted with man, and, from experience, learned that his presence assured them a great abundance of food at much less labor than formerly, while, at the same time, their natural enemies decreased in numbers on account of his necessity and pleasure. In some localities, owing to the persecution of a neighborhood of farmers, muskrats are few in numbers and are very shy. In the greater number of places, however, but little attention is paid to their destruction, and in consequence they become very tame, being found within the corporate limits of some of our larger towns. Originally, they had their home in the neighborhood of natural water-courses, but with the system of State improvements which led to the building of our canals there came, in many localities, a change in the life of the muskrats. Upon the completion of the White Water Valley Canal, in 1846, the greater number of muskrats living upon the streams along which it ran sought this artificial waterway, and there established homes. No doubt they soon realized the greater security this canal afforded them from the frequent floods and from other dangers they had formerly experienced. At the present time, along that portion of the canal in existence, but few muskrats have sought the neighboring streams whence their ancestors came. When the muskrats changed their residence to the line of the canal, they made new homes in its loamy banks, similar to the ones they had deserted along the river side. They are found both in our water-power canal and in the swifter streams, most numerous where there is a good food supply and at the same time near by a quiet nook secluded from the prying eyes of some human enemy and his allies. I have noticed them to be exceedingly abundant about the estuaries of creeks whose banks are covered with a luxuriant growth of vegetation.

When the canal through this part of the State was destroyed in 1866, the rats disappeared from many places where they had long found a home. Some sought the river where their ancestors had dug their holes in times long past; others gathered into certain parts of the old canal bed which were not permitted to remain unused. One of these portions is now the property of the Brookville and Metamora Hydraulic Company, and is used for the purpose of supplying power to several mills along its banks. This part of the old canal is about fifteen miles long, extending from Laurel to Brookville. It is here that I have become best acquainted with this water-loving rodent.

The muskrat prefers its home in banks of loam or light clay, especially when heavily covered by vegetation. It is very exceptional that it occupies gravelly or sandy banks. Advantage has been taken of this fact by the managers of our water-way and by the railroad company. Where they have constructed gravel banks and kept them free from vegetable growth, it is rarely they are bothered. Trenching the banks and filling in the trenches with gravel has proved of considerable value, while some protection has been afforded by a top-dressing of coarse gravel over an old bank of loam, provided vegetation is not allowed to grow thereon. When these precautions have not been taken, great damage is done each year; the burrows of these animals are continually being enlarged, and caving in cause a leak, or undermine the railroad track, as the case may be.

In early spring the greatest damage is done. With the alternate freezing and thawing at that time of the year, the coverings of these underground passages drop in, exposing cavities of surprising extent to one who does not know the amount of subterranean work this animal is capable of doing. It requires vigilant work of eyes and ears to prevent this caving causing great damage to property. The underground homes of the muskrat in the banks of the canal have each two openings. When the water is at its usual stage, an opening may be found, the upper edge of which is on a level with the surface of the water; another hole may be seen at low-water mark, the top of which is just level with the surface of the water at that stage. These holes are generally from eighteen inches to two feet apart. The passages from these openings lead backward and upward in a very crooked way, as any one who has attempted to follow them up can testify. These passages end in a large gallery which is the home of the animal. From this chamber a small passage leads to the surface, ending amid a bunch of grass or weeds. By this means the gallery is ventilated. The holes at the surface are known as "air holes." They are not always found, at least I have not in all instances observed them. In heavy ground an "air hole" is always found, while in porous ground it is as often absent as not. These underground burrows extend into the bank a distance of ten to twenty feet in a straight line, as a rule. Instances have been noted where the depth reached was less than the minimum given above, but such are rare. In localities along small streams which are subject to sudden rises, the distance attained occasionally reaches thirty feet; but in all instances the depth to which these burrows reach depends, in a great measure, upon the size and composition of a bank as well as upon the liability of the neighboring stream to sudden changes of level.

In the abandoned parts of the old canal before referred to, the muskrat built houses for the first time in this part of the State. They were few in number, and were confined to wet tracts, the source of whose water supply was springs from the neighboring Silurian hills or in swamps adjacent to the line of the canal. Until within the past three years no houses had been built along the water-power canal between Brookville and Laurel. Each succeeding year I noticed the erection of a few more houses, until at this time there are a dozen or more within the fifteen miles just mentioned. Within ten miles of the northern end of this artificial waterway, in the old bed of the canal, have been several houses for a number of years. Whether this house-building habit is caused by some of the house-building muskrats coming from up the stream, or whether, from some unknown reason, the animals of our own locality have thus taken upon themselves this much of the ways of some distant ancestor, we cannot say. That muskrats do, from force of circumstances, change their location is a well-known fact, and such a change would perhaps be the most logical way to account for the recent house-building just mentioned.

I have made careful examination of some of these houses, and herewith present some extracts from my notes on one of them which I consider typical in construction and arrangement. The examination of this house was made in January last, when the ground was frozen, but the more rapid streams had little or no ice upon them. This particular house was built upon the highest part of a piece of marshy ground on a peninsula extending into a stream which passed through the marsh. The end of the peninsula had been dug off to the level of the bottom of the stream, leaving a semicircular exposure of land. A part of the base of the house followed the configuration of the edge of this excavation, while the remainder of the foundation rested upon the bottom of the stream. In consequence of this, rather more than half of the house adjoined the water. The house was composed chiefly of swamp grass, sedge, coarse weeds, and mud, while fresh-water algæ, small pieces of drift, a few pieces of shingles, and two staves were found among the more common material. The greater part of the mud was in the lower part of the house, and I think was mostly brought in attached to the roots of grass. The ground in the neighborhood of this house was cleared of all vegetation, even of the roots, for some distance. The house was thatched very nicely with weeds and sedge. The ground plan was oval in outline, four feet six inches wide and six feet three inches long. On the land side the house was two feet six inches high, and on the water side three feet four inches. The whole presented the appearance, in miniature, of an oblong hay rick. The inside was quite irregular. Measurements at the bottom of the chamber showed the greatest length to be twenty-two inches, the least sixteen inches, with an average width of twelve inches. The greatest height, measuring from the bottom of the stream, was one foot. Six inches from the bottom a shelf was found running from the left of the entrance and above the top of the water. This shelf was twelve inches long and eight inches wide, and ranged from six to eight inches in height. It was arched over very neatly with drift and coarse weeds. At a point farthest from the center of the chamber, immediately over the shelf, was a passage leading upward toward the side of the house. While it did not penetrate the wall, it passed through the more compact portion, and enabled the inmates to obtain air. Entrace was had through a covered way from and beneath the water without to the center of the house, where it terminated in a mass of fine grass and mud, through which was a funnel-shaped opening to the interior. This house was completely destroyed; within a week after its destruction the muskrats had erected a new home upon the site of the old one. In securing material for this they had used the remains of the ruined house, and had cleared a much larger space of ground of its withered vegetation. In outline the new house resembled the old one very much, but it was of nearly double the size of the ruined structure.

There are peculiarities in the shape of many houses, but that which I have described appears typical in form and in interior arrangement of these structures in this vicinity. Some of these houses are built at a time when the water is low, and as the fall rains swell the streams the rats are compelled to reconstruct their buildings, raising the top above the highest level of the water. I knew a muskrat to try this plan last year. It built its house within the banks of an ice-pond which was almost dry; as the water was turned on, late in the fall, the owner tried, by making the house higher, to keep a portion of the structure above the encroaching water. An increase in altitude of six feet was too much for the industrious animal; by the time half this height was reached he gave up the work. Occasionally, instead of laying a part of the foundation out of the water, the house is begun entirely within the water. At times I have known a hollow stump, which had a lower opening beneath the water, to be used. The stump being covered over and some grass and other material placed around the base, it required close observation to recognize the framework of the structure. I have known these animals to take possession of a barrel which stood on its end in the water, and after covering it over so as to almost hide it, to give up the work and erect a dwelling without the substantial assistance such an article would afford.

I find the muskrat lives, the greater part of the year, in its sinuous galleries in the banks of our streams. Each autumn new houses are built or old ones repaired, but these are only occupied when the surrounding streams are locked in a sheet of ice. At such times it is by no means uncommon to find several representatives of the species living in harmony within one of these winter homes. I am convinced that in this vicinity one brood of muskrats is regularly brought forth each year. There are, in all probability, occasional exceptions to this rule, when perhaps two and even three broods are born. Mating takes place late in February or early in March, depending upon the condition of the weather, and continues about three weeks. This year these animals were first noted as mating on March 10th. At this season the female utters a hoarse squeal by which the males are attracted. The period of gestation is about six weeks. In April or early May the young are brought forth; from four to six helpless and hairless little creatures may then be found by the persevering investigator far within the subterranean home within a nest of grass and other soft vegetable growth. The young remain in the nest until they are about half grown, unless their home be flooded, when they often perish, but in some instances are rescued by the mother. Mr. E. R. Quick relates one instance when, during a flood, July 3, 1873, he saw a female muskrat swimming along in the muddy water with five young, about the size of a full-grown house rat, holding on to tufts of the mother's hair with their mouths, while she made her way slowly and cautiously along the shore; carefully she avoided all obstructions and swift water, seeking a shelter for her precious tow. Some boyish enemy, perceiving the homeless family, threw a stone which struck the mother and scattered the young. The latter apparently knew nothing of diving and but little of swimming; with difficulty they gained the shore, and while seeking the protection of some reeds a part of them were caught. I have never found the young caring for themselves until after the beginning of July. In September, a few years since, a litter of young was taken from a nest in the canal bank. They were not over one-third grown. This record I have always considered as referring to a second or perhaps a third brood, and is my only note that would indicate a plurality of broods.

During the rutting season the grunts of the males answer the squealing of the females, the noise of scuffles between the males, the continuous splashing made by the animals in the water fill the air, in the vicinity of one of their favorite ponds, with sounds which would surprise one who was not familiar with the neighborhood of a muskrat's home on a warm night in early spring. At this time of the year they are seen during daylight more than at any other, sometimes even deigning to show their love-making to inquiring eyes.

Muskrats are naturally herbivorous. They feed upon land and water plants alike, in some instances using roots, stems, and fruit. They are noted enemies of the "bottom" farmer. In his fields it is that corn grows most plentifully, and upon this cereal muskrats love to feed. They eat corn at any time after it is planted, taking the seed from the ground or the young plant from the furrow. The greatest damage is done after the ear is well formed. "Roasting ears" appear to be a favorite article of food with them. From this time until the corn is gathered, nightly visits are made to the neighboring cornfield, where the stalks are cut down and sometimes carried to their homes, but more frequently the juicy ear is the only part taken. At times streams near cornfields seem covered with floating stalks, the result of the muskrat's nocturnal forays. As the corn becomes hard, it is frequently a difficult question for them to tell how they will get the grains off the cob as easily as formerly. They evidently master the question in some instances, for I have known them to deposit the flinty ears in a stream for two or three days until the grains become soft, when they could be readily removed. It seems strange that an animal having teeth of the cutting power those of the muskrat possess, should seek to do this, but in all probability the teeth, from continued eating of vegetable food throughout the summer, become tender, and are unable to cut hard grains of corn with ease. This is the case with many domestic animals in autumn when fed on corn after some months of pasture life. Muskrats are very fond of parsnips, turnips, and apples. They frequent apple orchards and turnip patches, near their homes, and make use of much of the farmer's abundant crop of these articles. When snow, which had lain on the ground for some time melted, I have observed that plats of grass near the water's edge had been eaten bare by these animals while they were confined to such diet as they could find beneath the ice. Their food is not entirely vegetable; in winter and in early spring they subsist, in a great part, upon the flesh of river mussels. Many a winter morning have I found a number of well cleaned shells of the more delicate mussels upon the ice near swift running water. I have never been able to satisfy myself that this food was used by them at any other time of the year. Neither do I believe that this mate-

* Read before the section of Biology of the American Association for the Advancement of Science at Ann Arbor, Mich., Aug. 27, 1885.—*Amer. Naturalist.*

rial was originally so used. It is very probable that, owing to the scarcity of suitable vegetable food, they have been forced to include the meat of the mussel among their articles of diet—largely on account of its abundance near their watery haunts, and also on account of the ease with which it is obtained. Such change of food has not occurred in this region within historic time, perhaps, but it is evident that formerly, when there were few mussels in these rivers, not so many of them were eaten. With the conditions favorable to their development produced by our canal, mussels multiplied very rapidly, and in proportion to their increase in numbers the muskrat increased his mussel-eating. Records of this are preserved in the banks of the canal; alternate deposits of shells, cleaned by the muskrat, and of sediment may be seen in many localities reaching to the depth of two feet below the present bed of the stream. Under these same piles of bivalve remains the muskrat leaves the remains of most of the mussels it eats. I have never known the muskrat to eat univalve mollusks. I have identified the following shells as forming the principal part of its bivalve food in this vicinity: *Anodonta plana* Lea, *A. decora* Lea, *A. imbecillus* Say, *Unio luteolus* Lam., *U. parvus* Barnes, *Margaritana rugosa* Lea, and *M. complanata* Lea, all common in proportion to their comparative abundance. In some localities I found the young of *Unio occidens* Lea, but not very common. In another locality, where *Unio lachrymosus* Lea is the prevailing species, I found its shells forming the bulk of the refuse near muskrat homes. In this same locality I found examples of *Unio plicatus* Le S. and *U. multiplicatus* Lea, but they were not common. The young of heavier shells are to be found as commonly, in proportion to their abundance in the adjacent water, as are the remains of the more fragile species. I have estimated that about one-half the mollusks eaten are of the three species of Anodonta. I was surprised at the comparative abundance of the remains of *Margaritana rugosa* Lea in these piles of shells. This species is considered to be rather rare, but their shells are found as frequently there as are those of some of our more common species. From this fact I think the muskrat prefers the flesh of this species to that of others which might be more easily taken. I have, at times, found examples of living Unios among these heaps of shells; whether these had been brought there by the rats, or whether they had sought, of their own accord, a dwelling place among the remains of their dead ancestors, I cannot say. The means by which the muskrat secures the body of a mussel has been frequently discussed of late. I think, from my observations, there are three ways in which these shells are opened. With many species I notice that the foot is very slowly withdrawn within the covering when the shell is handled. When such shells are taken, it is very easy for the muskrat to insert its paws or long teeth between the valves and tear them asunder. The remains of some species show evidence of the cutting power of their enemy's teeth—the edges are broken; when this is done, it would be very easy for the muskrat to find a sufficient opening to secure the animal as in the preceding instance. By those two ways the more fragile shells may be opened; the heavier species which are occasionally found, nicely cleaned, about the opening of the muskrat's home, could not be opened in this manner. I have on several occasions noticed these larger mussels lying on the bank of a stream near a muskrat hole, and within a few days they disappeared. The only way in which I can see the muskrat could obtain the body of one of these larger mollusks is by leaving the animal out of the water until it becomes weak or until it dies, when the valves could be easily separated. Muskrats at times eat of the bodies of dead animals. The remains of ducks, geese, chickens, fish, and even in one instance a turtle, have been noted as forming a part of their food. The farmers of the lowlands ascribe to the muskrat a love for young ducks, but I think the greater part of their loss in this particular is referable to turtles.

The muskrat is largely nocturnal in its habits. On cloudy days and occasionally late in the afternoon one may be seen, along some quiet stretch of water, seeking food or looking for its mate. It is not much at ease on land, although when pursued it moves over the ground at an ambling gait with some degree of rapidity. It is an expert at swimming and diving. Before diving it appears to inflate its lungs with air, and when it disappears remains beneath the water for some time, the course it takes being frequently traceable by rising bubbles of air. When surprised, it plunges into the water suddenly without the necessary supply of air, and is forced to come to the surface in a very short time. When frightened, it generally seeks its hole, but such is not always the case. In open water it dives to a considerable depth, and I have noticed it passing through shallow water, apparently running upon the bottom. Under the ice it may be noticed, at times, swimming quite close to the surface of the water. It appears disinclined to dive in muddy water. Upon several occasions, when our streams have been swollen, I have attempted to make one dive by stoning it, but generally without success; sometimes it would dive, but would almost immediately reappear. When our water-courses are covered with ice, the muskrat has regular places of egress and ingress, such places being where, owing to swift water, ice has not formed, or where the ice along the banks of a stream has become broken.

Several methods are employed to capture or to kill muskrats. Many of them are caught by means of steel traps. They are very unsuspicious, and regularly become the victims of their self assurance. A dead fall is frequently used with some effect. It is generally placed over a well-worn runway leading to a favorite feeding ground. Many muskrats are killed by means of poisoned apples or turnips which are placed in the neighborhood of their burrows. The latter plan is often tried by the farmers of our uplands to kill these animals when they become too numerous in the ditches and smaller streams. A method used with great success by a local water-power company, in winter, is as follows: A barrel with both ends out is placed upright near the bank with about half its length in the water. Upon the water inside the barrel is placed grass and weeds, and on this foundation the bait, generally a few pieces of parsnip, is put. In a few days the animals will become familiar with this new object, and thereafter the barrel may be visited regularly. After a warm night the trapper is reasonably sure of finding some game in his barrel. Sometimes he will find but one or two rats, but more frequently he will catch from three to six, and on one occasion I have known ten rats to be taken in one barrel in a single night. At mating time, if a female be caught, several males will be taken prisoners in the same barrel in their efforts to become her company. When a rat gets into the barrel, it is impossible, owing to the depth of the water, for it to stand upon its hinder limbs to cut a hole in the staves above the water line, and at the same time impossible for it to get out at the top of the barrel. When several are taken the same night a fight generally ensues, resulting in the death of all of the captives, either by the sharp teeth of their companions or by drowning. I have known instances where several of these rats had been captured and killed, but the trapper did not visit his traps for some time; upon his arrival, however, he found but a few heads and bones to tell of the tragedy that had been enacted and of the feasts which the other muskrats had when the water receded enough for them to enter and leave the barrel. This habit is not uncommon when more acceptable food is scarce. Last spring a muskrat was caught in a steel trap; when the trapper went to his trap next morning, he found another rat eating the dead one; upon examination, it was found that the entire right shoulder had been eaten off. Spears are rarely used, but they are sometimes brought into service when the streams are ice-bound to kill the inhabitants of a winter house. Many muskrats are shot in early spring, when the ice breaks up.

Of the enemies of the muskrat, man ranks first, and next to him the dog. Hawks and owls of the larger species, foxes, and minks are all very destructive to this animal. The mink is perhaps its greatest natural enemy, but fortunately for it minks are rare. The remains of muskrats have, on several occasions, been found in the stomach of large catfish, but the flavor of the food had been so thoroughly imparted to the meat of the fish that it was unfit to eat. The muskrat is at times very ferocious. When cornered by dogs or man, it frequently shows fight; and if pressed too closely, is able to do much execution with its sharp teeth.

Muskrats have their pleasures as do other animals; but as their favorite time for sport is after night, we have but little opportunity to become acquainted with them socially. On a warm quiet afternoon they appear to enjoy a sunning in some secluded spot. Their gambols in the water, of a quiet evening, remind me much of the playing of kittens. They may be seen at times, of a moonlight night, chasing each other over some sand bar near their watery home. On the whole, the study of their enjoyments is very unsatisfactory, and much of our knowledge of the life history of these animals will be but slowly acquired.

A PECULIAR ORIENTAL LOCALITY FOR HONEY.*

XENOPHON, in his description of the "Retreat of the Ten Thousand," says that his soldiers drank barley wine, oinon kritys, as it had been introduced into Egypt by Osyris 4,000 years previously, according to the Egyptian tradition, to take the place of other spirituous liquors. Sophocles and other writers mention this barley wine also. Xenophon says likewise that his soldiers were in the habit of getting drunk by the use of a certain kind of honey, and were poisoned by it. It seems that the bees suck the nectar from the flowers of poisonous plants which are found in that region. Such an intoxicating, soporific honey is still found there under the name of *Meli menomenon*. I have succeeded by many tedious investigations in establishing the following. I obtained the information principally through a former pupil of mine who is now settled in Kerchasund in Persia as a physician and apothecary.

I have already reported to you upon the Oriental mania for opium. But the opium which is produced for Western countries and for China is very little in comparison with the domestic consumption. In the district around Erzeroum, around Kerchasund, and farther into the Persian districts are to be found colossal plantations, whose product is almost exclusively used where produced.

In all probability it is the nectar from these poppy plants which gives the honey in those regions its toxic qualities.

The honey is used as a soporific for children, and is employed also against various affections, especially such as arise from improper food—sour milk, badly cooked rice, goat's milk, etc.—as for instance colic, and often is of aid where symptoms of death have already appeared.

The opium which is collected from the opium plants in those regions contains usually 12 per cent., and rarely less than 10 per cent., of morphine. I had an opportunity to see such opium in the possession of a Persian merchant. It consisted of round balls of a few drachms weight which were wrapped in goldleaf. This is the kind which is used principally for smoking and chewing.

* Translated from Prof. Dr. Xaver Landerer's "Mittheilungen aus dem orient" (Deutsch-amer. apotheker-zeitung, 15 Dec., 1882, jahrg. 2, p. 582). —*Psyche.*

ANALYSIS OF BLACK SOIL OF MANITOBA.

By J. M. H. MUNRO, D.Sc., F.C.S.

THE subjoined analysis gives the composition of a sample of black prairie soil, taken from a farm near Birtle, Manitoba, by Prof. J. P. Sheldon, during one of his recent visits to that district. The sample was taken from the first 12 inches of depth, and when dried at 100° C. consisted of:

Organic matter and combined water	9·70
Small stones and gravel	1·41
Gravelly sand	2·45
Coarse sand	64·20
Fine sand	11·70
Clay, so-called, ignited	10·54
Total	100·00
Associated in air-dried soil with:	
Moisture	6·70
Large stones	none
Total	106·70

The fine earth (passing through a sieve 30 meshes to the inch), when dried at 100°, contained:

Organic matter and combined water	10·07
Silica and insoluble silicates	83·41
Ferric oxide and alumina	4·195
Carbonate of lime	0·96
Magnesia (MgO)	0·487
Potash (K_2O)	0·271
Phosphoric acid (P_2O_5)	0·195
Chlorine	0·010
Sulphuric acid	trace
Total	99·598
Total nitrogen	0·412
Total minerals soluble in water	0·048
Potash (K_2O) soluble in water	0·0081

The sample examined may be described as a fine sandy soil, remarkably free from stones, and owing its dark color to vegetable matter, of which it contains a large quantity. The sand and gravel consist chiefly of fragments of quartz, with an admixture of spangles of mica and other minerals derived from the older rocks. The proportion of nitrogen is very high, even when compared with the best English pasture soils. Potash and phosphoric acid are also in abundant supply, and the only element of fertility threatening to become deficient is *lime*. The high relative proportion of magnesia is note-worthy in connection with the grain-growing capacity of this soil.—*Chemical News.*

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